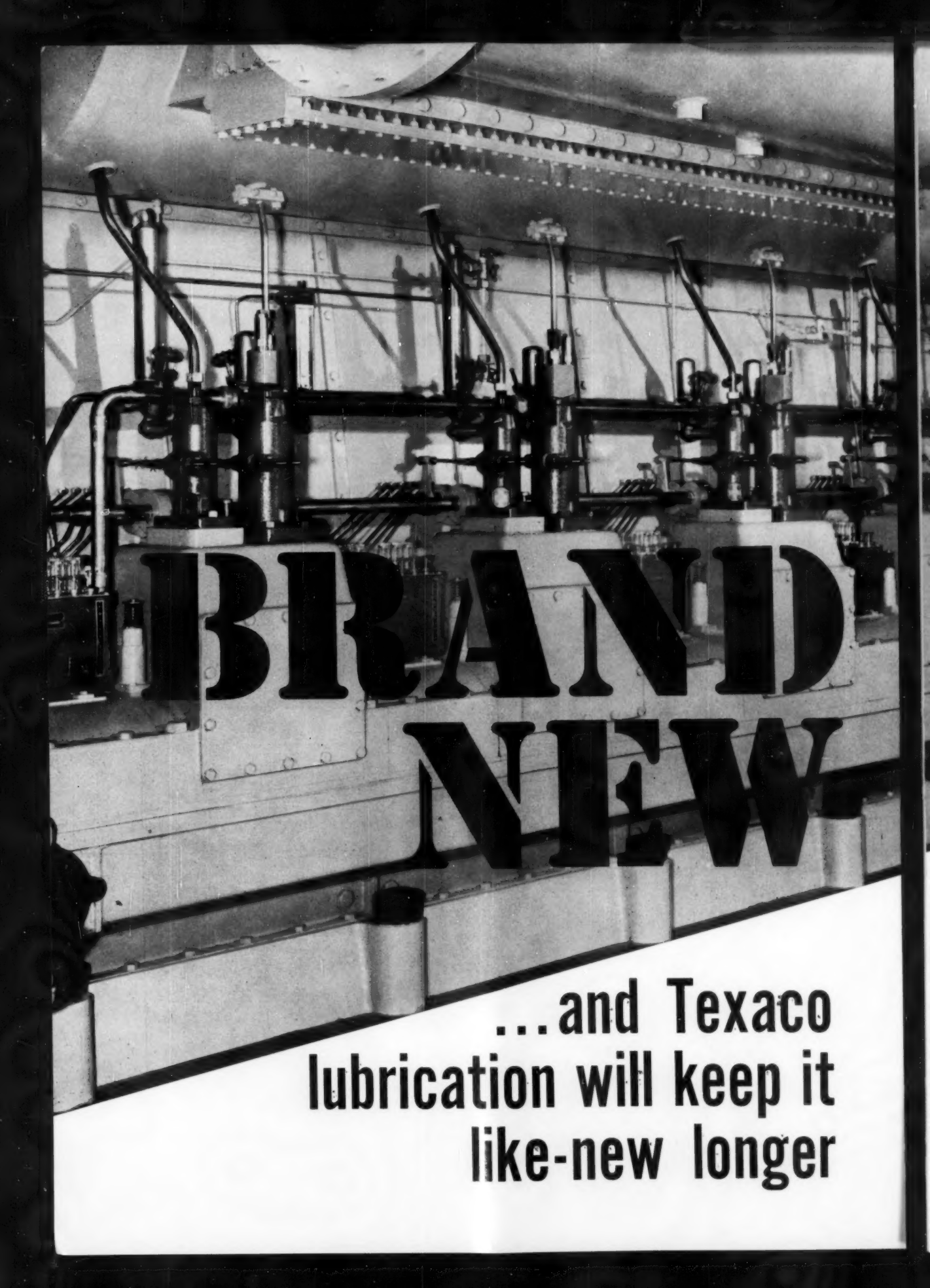
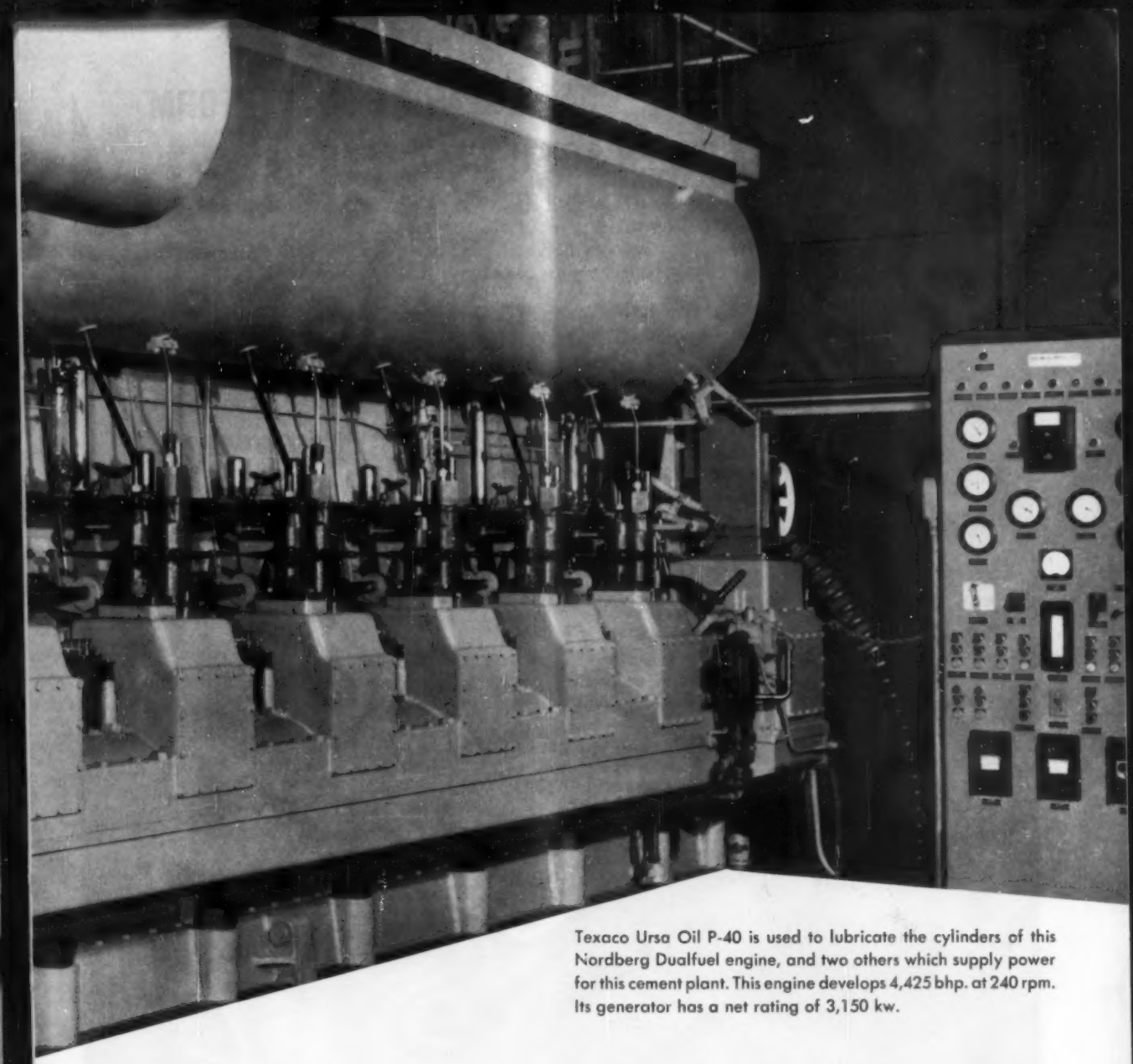
# diesel power

September 1958




...and Texaco
lubrication will keep it
like-new longer



Texaco Ursa Oil P-40 is used to lubricate the cylinders of this Nordberg Dualfuel engine, and two others which supply power for this cement plant. This engine develops 4,425 bhp. at 240 rpm. Its generator has a net rating of 3,150 kw.

This is the newest of three Nordberg engines in the power plant of one of the country's leading cement producers (name on request). All three engines use Texaco Ursa Oil, so the like-new qualities—low maintenance, full power, high fuel economy—will last longer.

Texaco Ursa Oil assures full compression and complete combustion by keeping the rings free. By resisting oxidation, it minimizes sludge formation and keeps the engine free of harmful deposits.

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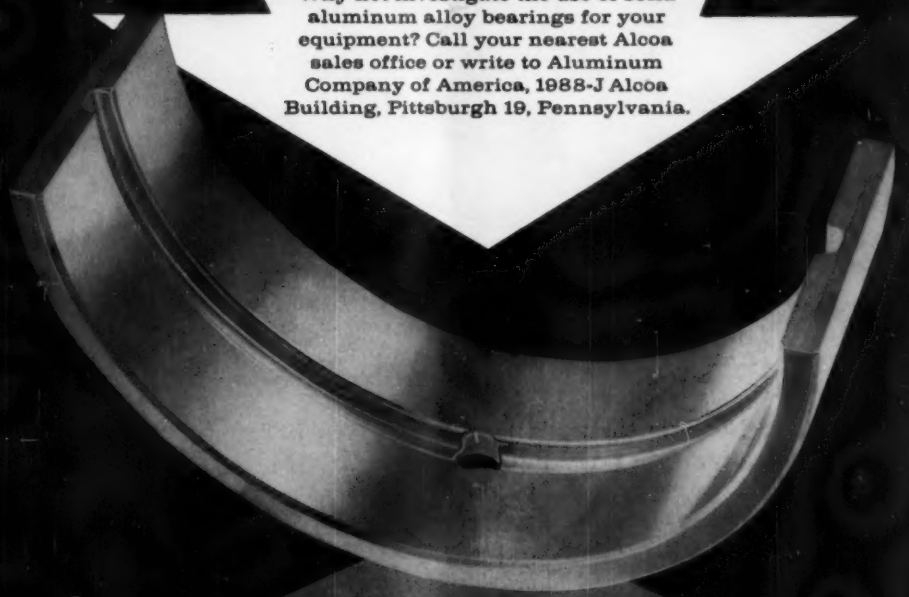
**Why not investigate the use of solid aluminum alloy bearings for your equipment? Call your nearest Alcoa sales office or write to Aluminum Company of America, 1988-J Alcoa Building, Pittsburgh 19, Pennsylvania.**



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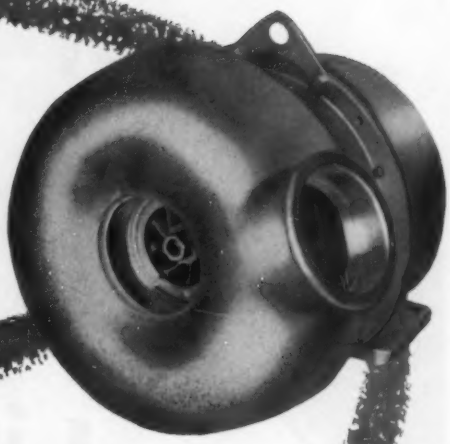
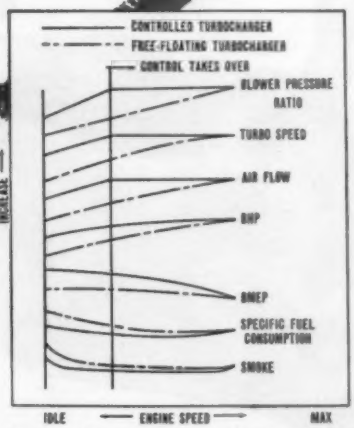


## AiResearch control system keeps turbocharger output at ideal level




*Improved performance characteristics of a typical turbocharged diesel engine equipped with the new AiResearch Turbocharger Control System.*

**Accurate control of turbocharger speed over its complete range regardless of changing load characteristics** has been achieved with the new AiResearch Turbocharger Control System. This automatic control system delivers more air to the engine when needed and greatly increases torque rise, giving turbocharged diesel engines greater lugging ability when operating under heavy loads. By contrast, free-floating turbochargers operate at reduced RPM when the engine is working at below-maximum engine speed.

This improved air delivery system greatly increases the acceleration, for example, of turbocharged diesel trucks up steep grades. In a typical case, the round-trip time of a trucking company operating between Phoenix and Denver was cut from 48 hours to 42 hours. Over short hauls an off-the-road truck cut its 27-minute round-trip time to 18 minutes. Comparable gains are made for all types of turbocharged diesel equipment, stationary or mobile.

The two components of the new control system are a pressure ratio sensor and an exhaust by-pass valve. They control the speed of exhaust-driven turbochargers by modulating the amount of engine exhaust used. This eliminates overspeeding of the turboblower, and at the same time provides higher turboblower speed while lugging. Smoking is virtually eliminated under all conditions.

Your inquiries are invited.

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BPA

# diesel power

**Established in 1923 Vol. 36, No. 9 September, 1958**

**The Magazine of Piston and Turbine Power**

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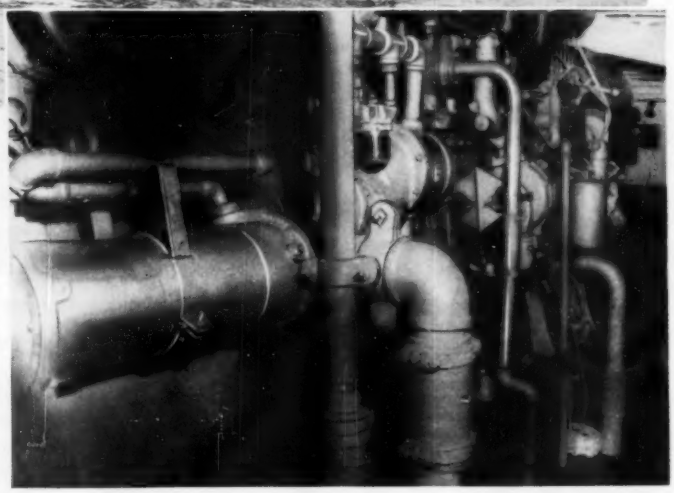
**Diesel Publications, Inc., 80 Lincoln Avenue, Stamford, Conn.**

A typical Waukesha Defender (LRD Series) Turbocharged Marine Diesel installation



# rebuilt and REPOWERED with WAUKESHA *turbocharged* MARINE DIESELS

All new . . . except steel deckhouse shell, part of the hull and the three-toned whistles . . . the *Beryl* is not only renamed and rebuilt; but repowered with two Waukesha Defenders. That means new engine performance for this vessel . . . and for the owners, Cumberland Sand & Gravel Co., Nashville, Tenn. Providing main propulsion, the two Waukesha Defenders (Model LRDBSM 8½ x 8½-in., 2894 cu. in.) Turbocharged Marine Diesels drive two 60 x 36-inch, 4-blade steel propellers through Snow-Nabstedt 2.92:1 reverse-reduction gears.

The owners say that they are completely satisfied with this new "power-packed" workboat, particularly its "maneuverability" under all conditions. Waukesha Marine Diesels range in size from 426 to 5788 cu. in.; Normal Aspiration or Turbocharged up to 990 hp. max. for 24-hour duty. Send for Marine Bulletins.

377

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# ...for high speeds...high horsepower

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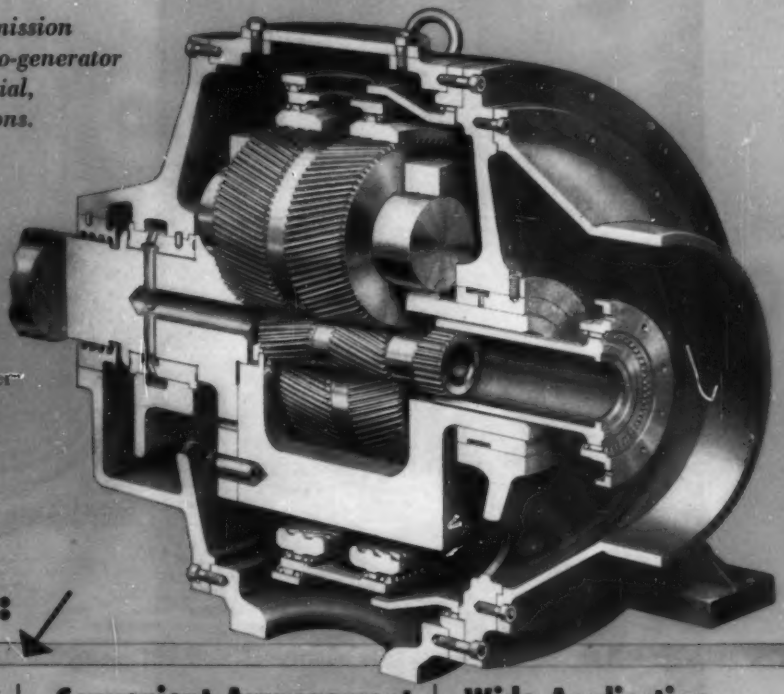
*For all high torque power transmission applications such as pump turbo-generator and compressor drives in industrial, municipal and marine installations.*

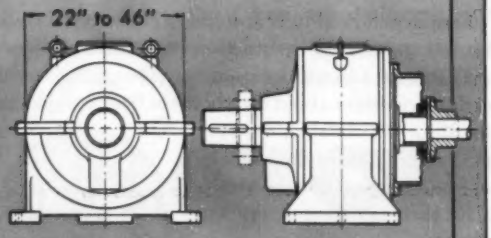
This cutaway view of the De Laval-Stoeckicht Planetary Gear shows how it provides flexibility for proper load distribution throughout the gear members. The thoroughly proved and tested design is completely reliable in transmitting high horsepower for high speed applications. • Highest efficiencies (98% or higher)... no high speed bearings... less friction losses.



## Check These Advantages:

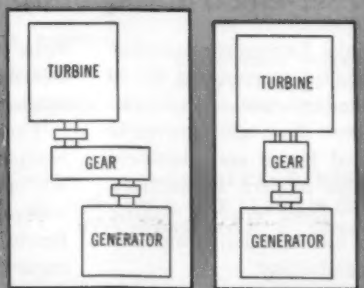
### Small Size—Light Weight

Compact—low weight per hp. Sizes range from 22" to 46" in diameter, depending on horsepower requirements. Example: 5000 hp planetary unit weighs 1700 lbs. against 6000 lbs. for conventional gear.



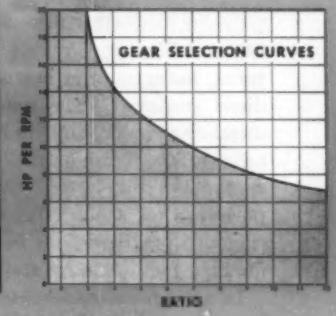

### Convenient Arrangement

Co-axial or "in-line" arrangement of gear members takes up far less space than parallel axis gears of equivalent horsepower rating.




### Wide Application

Capacity range shown in shaded area on chart below. For other applications, contact your De Laval Sales Engineer.



**For further details, write for Bulletin 2400.**

**DE LAVAL** *Steam Turbine Company*

*Nottingham Way, Trenton 2, New Jersey*

# BENDIX FUEL INJECTION EQUIPMENT...

## *Speeds diesel-electric locomotives around the world!*

General Electric, 65 years a major locomotive manufacturer, insists on the best of quality components for its diesel engines. Their new standard line of universal diesel-electric locomotives has been thoroughly proven in railroad use both in the United States and elsewhere throughout the world. And these modern locomotives, powered by Cooper-Bessemer diesel engines, utilize standard precision-built Bendix fuel injection equipment for high fuel economy and dependability.

In areas from sea level to 14,700-foot altitudes, in temperatures ranging from 130°F to −65°F, in remote locations where dependability is absolutely necessary, Bendix injection equipment has operated at maximum efficiency to speed General Electric locomotives around the world.

There's no question about the choice of Bendix injection equipment for dependable, economical operation. That is why so many leading diesel manufacturers specify Bendix for their injection equipment requirements.

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# Are Your Engines Plagued by Failures Like This?

## Eaton Engineers Can Help You Solve This Problem

**The photographs above illustrate a typical fatigue-type failure caused by overstressing, in which fracture starts at the surface and, with repeated high stress, progresses to final break.**

**If you are an engine manufacturer and are having valve gear problems, Eaton engineers will be glad to consult with you and recommend procedures to help solve them. Or if you are designing new engines, perhaps our past valve experience can be valuable to you. Write, wire, or phone — there's no obligation.**

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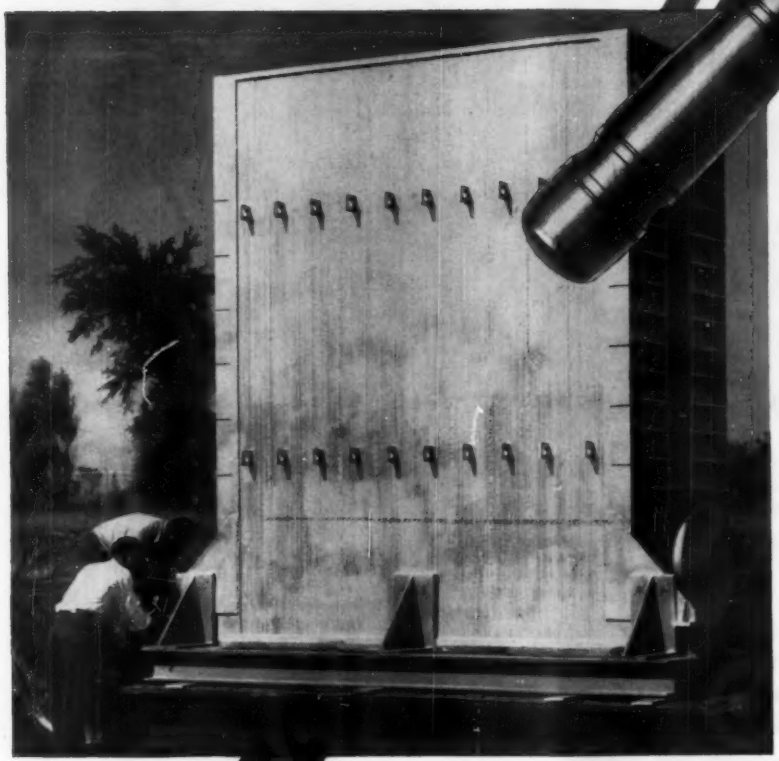
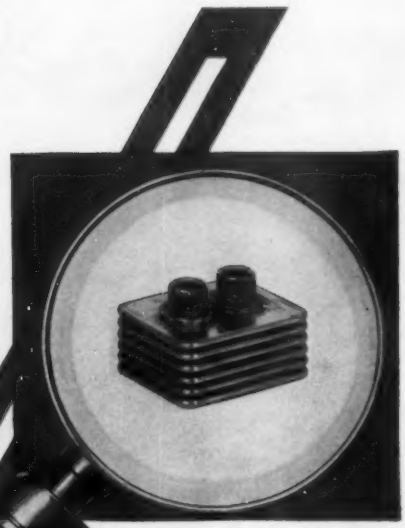
# HARRISON SIZES UP THE JOB...





↑

**2½ lb. diesel engine heat exchanger**

**← 58 ton gas turbine regenerator**

*Meet the large and small of it!*
At left is a half section of Harrison's new regenerator for a General Electric combustion gas turbine. The regenerator is used by GE to boost performance and economy on the nation's natural gas lines. The entire unit is approximately 12½ feet high, 10 feet wide and 10 feet deep.

The small but vital marine heat exchanger (above) cools the oil in engine gear boxes. It is less than three inches high, four inches wide and slightly more than three inches deep.

You'll find Harrison heat exchangers on all types of diesel equipment—automotive, marine and industrial. If you have a cooling problem, Harrison has the answer!

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# Editorially speaking -

## Teaching "Why"

One of the best assistants we ever had came to us right from engineering school. Time after time he was critical of design, of a shop layout, or of how some repair job was done. Now, a critical eye is good and not to be discouraged. It shows the person is thinking and has at least some knowledge on which to base an opinion. The "some" knowledge in this case was largely academic. He hadn't been out of school long enough to know that the way people do things is rarely based on pure engineering principles. We taught him that things were generally a compromise that took into account costs, production techniques applicable, tooling and plant facilities available, market potential, customer preferences and even prejudices. Once made aware of such influencing factors, he was quick to grasp the "why" of things. His decisions became sounder and he did a better job. Explaining "why" was worth the effort. It should be part of any personnel training program. Here's another case. Stewart & Stevenson Services, Inc. of Houston gets the bulk of their service personnel from the diesel technician courses at the University of Houston. Yet does a new man go right into the shop? No, sir. He's assigned to one of the better salesmen and sticks with him for about six months. If it sounds crazy, try arguing with the firm's Annual Report. What's gained? First, the new man sees that sales of engines, parts and service pays all the bills. He meets the customers, learns their problems, sees their needs and feels the sense of urgency created by downtime. Exposed to a broad field, he learns some very practical angles of service faster. When back in the shop, he knows the "why" of doing a good job—what it means to the customer, to his employer and to his pay check. If it's a field call, he's geared to both doing the job and selling the customer on the service. If success is any yardstick, this method of teaching "why" certainly works. However, the point is to teach it; the method is secondary. It improves your people's skill, work quality and mental attitude. So it's good for you.

BPE

ENGINEER'S FIELD REPORT

PRODUCT RPM DELO OIL

FIRM M. M. SUNDT CONSTRUCTION CO. Tucson, Arizona

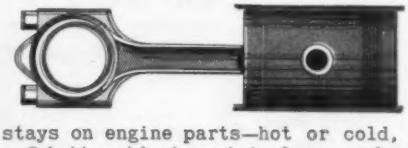
# RPM DELO OIL ends 5 years of engine troubles

**The pan has never been off** the Caterpillar D7 engine of this Link-Belt Speeder shovel in 7 years, using RPM DELO Oil. Only repair was a single valve job—no other parts replaced. William Naumann, Sundt's Operations Manager, says, "We tried nine different major brands of oil in five years, trying to lick the frequent breakdowns that slowed our operations. Sometimes, main and rod bearings even froze solid on the crankshaft. We changed to RPM DELO Oil seven years ago, and, since then, have never had any engine troubles due to oil failure. We now use RPM DELO Oil exclusively in our 22 heavy-duty engines."

**Lubricated with RPM DELO Oil,** this Caterpillar D 13000 portable unit powered a rock crusher of M. M. Sundt Construction Co. for a total of 8976 hours before overhaul. "In spite of extremely dusty conditions the only time the engine was touched was to replace a head—no other repairs were necessary," reports master mechanic Billy Gray, shown replacing air cleaner on unit following overhaul.

**Austin 101 rock crusher,** powered by Caterpillar unit described above, works 20 hours a day at firm's materials stockpile outside Tucson. Company works year around on road paving, grading, foundations, building construction.

**Why RPM DELO Oils reduce wear —prolong engine life**



● Oil stays on engine parts—hot or cold, running or idle ● Anti-oxidant resists lacquer formation ● Detergent keeps parts clean ● Special compounds prevent corrosion of bearings ● Inhibitor resists crankcase foaming

LUBRICATING OILS RPM DELO

**For More Information** or the name of your nearest distributor, write or call any of the companies listed.

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**STANDARD OIL COMPANY OF TEXAS,** El Paso
**THE CALIFORNIA COMPANY,** Denver 1, Colorado

# highlights

**A British-built diesel will power Ford's F-600 trucks.** The trucks, with Perkins Model F340, 6-cyl, 4-in bore, 4.5-in. stroke, 110-hp, 2850-rpm diesels, will be available from all Ford sales and assembly plants outside America.

**New test code for rating diesels** is on the way according to the SAE. Committee is hopeful of improving present methods of correction for atmospheric variations and also, standard temperature may be dropped from 90°F to 85°F. Results are more uniform.

**Accurate measuring of spark-ignition engine firing pressures is now possible** with Kistler's SLM spark plug-pressure indicator. The instrument consists of a modified standard spark plug, a miniature SLM quartz pressure gauge, a high temperature cable, a special low noise cable and a Kistler Instrument Corp. calibrator.

**World's largest marine diesel will be built** by Burmeister & Wain of Denmark. The 12-cyl, 22,000-hp unit was ordered by the Belgian Oil Co. Petrofina to power a 45,000 ton tanker. B & W also made the largest stationary engine in the world now operating in the Orsted power plant in Copenhagen, Denmark. It drives a 12,500-kw generator.

**Railroads will get some relief** they have long been seeking when new bill clears President's desk. Provisions of bill for $500-million in government-backed loans for maintenance and new-equipment purchase should stimulate business activities of suppliers to the railroads. More controversial provisions concern rate-making and abandonment of unprofitable services. Let's hope they are used wisely.

**The Administration's methods of construction machinery disposal has been challenged** by H. D. Anderson, President of the Associated Equipment Distributors. In testimony before the House Committee on Government Operations, he said that local government agencies are being placed in competition with distributors and contractors. These agencies are receiving government surplus construction equipment at little or no cost and using it in competition with contractors. Its obvious that military establishments are buying more equipment than they need.

**Nickel is off the DOD Conservation list** along with a number of other materials. Elimination of all specification restrictions on use of nickel gives designers a free hand to take advantage of the excellent characteristics of nickel-bearing alloys in planning tomorrow's higher output engines.

**European trucking is almost exclusively diesel powered.** According to the SAE Journal, trend of truck design in Europe in the last decade has been to larger and faster trucks. Engine sizes are approaching American sizes and today will haul comparable loads at 50 to 60 mph. Earlier, road speeds were low, acceleration with low power, poor. But diesels they were, and today these engines are even more firmly entrenched.

**A railroad order for 268 diesel locomotives** will be split between the Electro-Motive Div. of GM and Alco Products, Inc. The Norfolk and Western Railway, a coal hauling railroad, has finally decided to dieselize completely and pay about $50 million for these units which will replace their steam locomotives. EMD will supply 192, GP-9, 1750-hp units and Alco 40, 1000-hp and 36, 1800-hp units. These units will completely dieselize the N & W in 18 months.

**Truck design is moving faster than ever.** There has been a breakaway from the conventional concept. Witness Kenworth's dromedary model designed for Pacific Intermountain Express. They have air suspension, dual-steering front axles and midship horizontal engine mounting. Engine designs are keeping pace, with higher power, lower weight and improved performance. This goes for transmissions too. More ratios with simplified shifting, improved automatics and semi-automatics put more engine power on the road where it counts.

**Diesel locomotive rebuilding at EMD is brisk.** They're working on their 1000th old unit. Savings to railroads having their diesels improved are almost as great as those realized in the original steam to diesel shift—30% or better. The Electro-Motive Div. of GM figures that 6500 more of its engines built since World War II will either have to be scrapped or be upgraded during the next five years. If railroads upgrade their units instead of buying new ones, they save $150 million and give EMD $700 million worth of business.

*Attractive West Plant adjoins church and school (not shown). It is acceptable neighbor from appearance and noise standpoint.*

# Waverly Adds Enterprise RV-16 Engine

**Open house marked completion of a three-quarter million dollar expansion and improvement program of the Waverly, Iowa, Municipal Utility. This climaxes—years of successful operation during which the Utility has provided dependable, low-cost power and contributed through plant earnings to easing the community tax burden.**

WAVERLY's Municipal Electric Utility is a "good neighbor" to its residents. Its two generating plants knock in the head any argument that a power plant has to be an eyesore or a nuisance. They are completely acceptable in their locations both functionally and esthetically. The well-landscaped and architecturally attractive West Plant is a prime example as it is located immediately adjacent to a church and a school.

As another neighborly act, these plants contribute to the city's welfare. They provide dependable electrical power at rates that without exception are lower than in surrounding communities. In addition, they pick up the tab for city services that would otherwise show up on the residents' tax bills.

During 1957, for example, 1,607,535 kw hr of electricity was furnished the city free for street lighting, water pumping, sewage treatment, traffic signals, etc. These services were valued at $51,914.10. Also, $26,000 was transferred to other city departments.

You've heard of rising taxes? Well, the 1952 city tax levy was 15.95 mills. The 1956 tax levy, payable in 1957, was 15.69 mills. We know that costs are up so the answer must lie in contributions made by the Electric Utility.

Waverly has grown and some industry has been attracted—and no wonder. This is another contribution—more business for local merchants and more jobs.

Now the city is completing a three-quarter million dollar plant improvement program, all to be paid out of plant revenue. In fact, the municipal utility has bootstrapped itself to its current estimated replacement value of 3-million dollars on earnings alone. Let's see how this came about.

## A Thumb-Nail History

Municipal power generation in Waverly dates back to 1904. The growth pattern, apart from interesting local overtones, is familiar. Hydro power—seasonal fluctuations in water availability and definite limitations to meet a growing demand curve. Steam—too costly. Then diesel power with its low cost and opportunity for expanding capacity.

Physical plant then became a problem. The East Light Plant, adjoining the hydro plant, was so hemmed in as to eliminate expansion possibility. The hydro plant with its 125-kw, 195-kw and 200-kw generators was and is run to capacity as determined by water availability. With the 200-kw, two 430-kw and a 750-kw diesel generators in the East Plant, there was insufficient firm capacity.

A short-range answer was to turbocharge the three largest diesels and increase their speed. This was stepped up from 327 to 360 rpm. With turbocharging, the 430-kw units were raised to 720 kw and the 720-kw machine up to 1160 kw for a total 1020-kw gain.

Studies of the projected load growth showed the advisability of a new plant. Thus, in 1949, the West Plant

*Mayor J. deNeui, Sr. and Supt. of Utilities Merritt Bushby stand beside the new engine. Placards were placed on key equipment for identification during Open House.*

*During Open House, visitors saw the results of the three-quarter million dollar plant improvement and expansion program.*

came into being with initial installation of a 1245-kw turbocharged Worthington generator set. A second and similar unit was installed later. Both are dual-fuel units. Provision was made for burning natural gas although at the time it was not available. This decision has since been justified.

Merritt Bushby, superintendent of Municipal Utilities, credits use of the relatively low-cost gas as being a major factor in avoiding rate increases. To this can be added efficient operation, efficient loading of engines and good engineering in the design and selection of new equipment.

This thumb-nail history has been pruned to a nub but there is enough left to make a major point. The operating record through the years and present financial status, including the acceptance of this latest bond issue, show that Waverly residents have demanded and gotten sound judgement and good management from their public officials. Success rarely "just happens".

Present city officials and their predecessors have done a good job of planning and execution. More, the present administration has kept the people aware of what was going on and the importance of the municipal utility to each of them. That's why they got an enthusiastic turnout at a 3-day Open House at the West Plant to show results of the huge improvement program—the new engine, generator, switchgear and improved distribution facilities.

## The New Engine

When Waverly bought a new engine they bought a big one—and an interesting one. A look at the load growth as projected to 1968 shows why a high capacity unit was chosen. Waverly residents visiting the plant had the added attraction of seeing a "first".

The engine is the 110-ton, 16-cyl Enterprise RV-16 and is the first to be installed in this country. It won't be the last as one is being installed in Ottawa, Kansas, with one on order for the Wolverine Electric Co-op, Big Rapids, Michigan. Several of the RV-16's are operating in the Middle East.

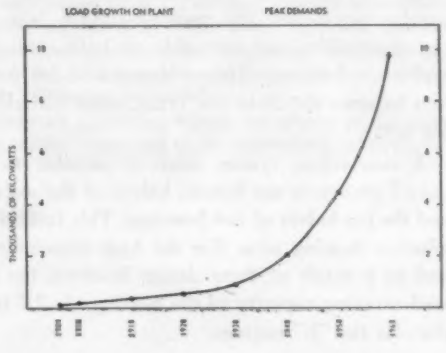
For the Waverly application as a dual-fuel engine, the RV-16 drives a 3500-kw generator. The engine is rated 4890 hp at 143 bmep and 360 rpm. This brings total utility capacity up to 9440 kw. Previous firm dependable capacity of 4095 kw has been raised to 5445 kw capacity which Mr. Bushby reports "will be more than enough for the city's immediate needs and reserves for several years to come."

Reserves will indeed be ample since this engine was designed with a top rated capacity of 7700 hp at 400 rpm. A higher capacity generator can be used when required. These engines are the most powerful and the first vee-type engines built by Enterprise. They stem from a management decision made in mid-1954 to extend the range of their engines to over 5000 horsepower. The RV's are built in both 12 and 16-cyl models.

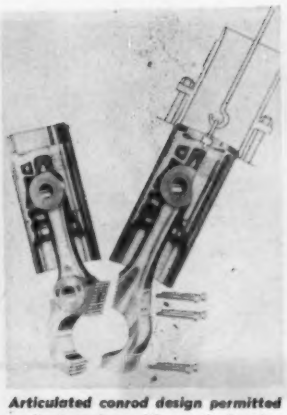
Larger bores and fewer cylinders were considered in the design stages but final decision was to use a vee configuration with 17-in. cylinder bores and a 21-in. stroke. This was the size of the Enterprise "R" Series. Many "R" Series parts could be used and these components were not only time-tested but in production, affecting costs.

The vee configuration contributed to compactness and offered weight-saving possibilities. Lower size and weight for a given output offer important economic advantages. Foundations can be lighter and structures smaller. Handling and installation are simplified.

*Growth of peak load demands projected through 1968 shows why Waverly selected a big engine with a power potential far greater than combined existing capacity.*



*Waverly's RV-16, a 110-ton package, leaves Enterprise plant. Compactness and lightness for its potential output is a big advantage for shipment and installation.*



*Articulated conrod design permitted a short engine with ample bearing capacity. Removal of bearing halves is possible through cylinder bores.*

Take the case of the Waverly engine. It was completely assembled and tested in the San Francisco shops, all openings were sealed, and it was shipped in one piece to Waverly. No erection was required at the site. Chances of errors in assembly, damage to parts or introduction of dirt under the field conditions was minimized. Also, installation time was shortened.

Speaking of shortness, one design objective was to build the engine as short as possible. This cuts space requirements and tends toward a more rigid engine. To do this, the "R" Series 24-in. cylinder center distance was retained. Corresponding cylinders in each bank were placed directly opposite each other. This could be done with the articulated connecting rod design illustrated.

To get the same bearing area, use of offset cylinders and side-by-side rods would have lengthened the engine 5-feet or 27%. Use of fork and blade rods figured to increase engine length 2¼-feet or 12%. With the articulated rod, length of this 16-cyl "package" comes to 22 ft, 8 in. from turbo to turbo. Height as installed is 12 ft, 8 in. and width, 9 ft, 4 in.

Another advantage was that even with allowing a large crankpin diameter and enough metal for a rigid bearing box, the master rod could be removed through its cylinder bore and the link rod and its half of the bearing box through the opposite bore.

Bearing areas are ample for the top engine rating. The crankshaft has 13-in. mains and 12-in. crank pins. These overlap two inches. The resulting rigidity is so great that re-entrant fillets are allowable on both connecting rods and main bearings. This makes the entire journal surface between the 26-in dia. crank webs available as bearing areas.

A new oiling system made it possible to eliminate the oil groove in the bottom halves of the main bearings and the top halves of rod bearings. This further increased effective bearing area. For the high anticipated ratings, and as a result of these design features, the calculated load carrying capacity of the bearings is 2.8 times more than for the "R" engines.

Higher ratings also dictated a higher flow of cooling oil to the pistons. Oil is supplied through the rods and is periodically subjected to inertia pressure set up by the oil column that exceeds the supply pressure. To prevent return flow, design is such that the crankpin acts as a rotary valve.

These are a few design features of this new Waverly engine. Like other engines in the West Plant it is arranged for dual-fuel operation. Turbocharged, each of four turbochargers supplies air to a common manifold and is driven by the exhaust from four cylinders.

Intake air is cleaned in a curtain-type filter, goes through silencers, the turbos' compressors and is aftercooled before entering the cylinders. The denser, cooler air increases permissible ratings and avoids possibility of detonation, particularly under high ambient temperature conditions.

The jacket water system is closed. Heat is dissipated in horizontal radiator units having 2-speed fans arranged for vertical upward air discharge. Thermostats control water flow and automatic controls cut in additional sections, adjust louvres and fan speeds to maintain even jacket water temperatures. A 50-gal surge tank is included in the system.

Fuel is supplied to the engine from a 300-gal day tank. Automatic controls maintain the day tank level within preset limits. Oil is filtered and supplied to the engine at proper pressure.

The lube oil system includes both strainers and filters. Sinclair Gascon HD oil is being used. A heat exchanger cools the oil and the water coolant temperature is kept low by evaporative cooling. Thermostats control the degree of oil cooling.

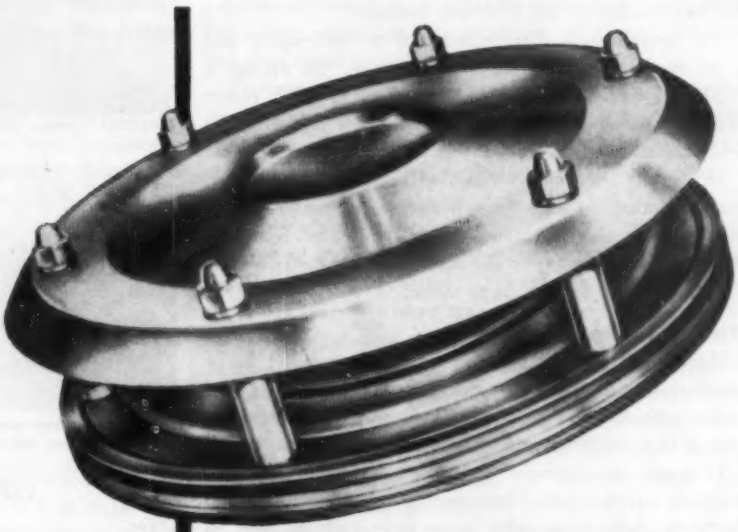
Safety controls protect the engine in several ways. First, there is a mechanical overspeed governor to cut off all fuel in case of excessive rpm. Second, controls protect against high water temperature or low lube oil pressure damage. Also, the engine is arranged to automatically revert to oil operation in the event of low gas pressure, low fuel or lube oil pressure, and electrical

(*Continued on Page* 18)

# IS THE LIFE OF A MAN WORTH THE PRICE OF A VALVE ?

# HOERBIGER

**crankcase safety valves**
**give POSITIVE PROTECTION against**
**disastrous marine explosions**



**Main advantages:**

**The HOERBIGER Crankcase Safety Valve is positively explosion-resistant by actual test ... operates without any failures even by serial explosions and highest explosion pressure.**

**It is oil-leakage proof ... releases pressure immediately ... prevents any inrush of air ... closes tight and immediately.**

**Flames from explosions are effectively deflected, thus reducing fire and hazardous situations thereby eliminating bodily injuries to personnel.**

**HOERBIGER Crankcase Valves are typical of the engineering excellence you find in all HOERBIGER products.**

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Braunhubergasse 23
Vienna XI/**Austria**

Hoerbiger & Co.
Schongau/Oberbayern
**Western Germany**

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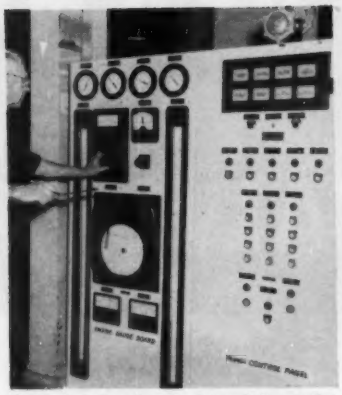
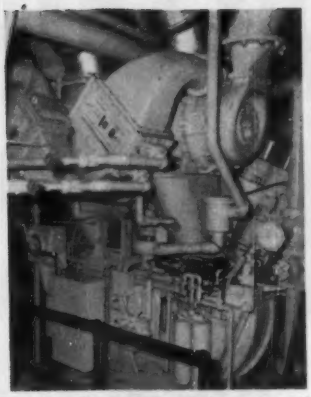
**HOERBIGER CORPORATION OF AMERICA**
**160 Van Brunt Street**
**BROOKLYN 31, NEW YORK, U. S. A.**
Subsidiary Company



*Gauge board and control panel for engine and associated equipment. Cylinder exhaust temperatures are being taken on pyrometer.*



*View of engine control end shows: operating lever; governor; 2 of 4 turbos and after-coolers; automatic and safety controls.*

*Lube oil filter used on existing engines is same type as that used on new one.*

(*Continued from Page* 16)

failure. Appropriate alarms are given and the engine shut down.

A full complement of engine instruments, including pyrometers, are available to the operators for monitoring the functioning of the different systems.

The generator is direct-connected to the engine and is of the single outboard bearing type. Its rating is 3500 kw, 3-phase, 60-cycle, 2400/4160-v, 80% power factor. A 30-kw exciter driven by a Poly-V belt provides field excitation.

The nearly three quarter-million dollar expansion program included not only the new engine, generator, switch gear, etc., but also new transformers, cables, etc. for interplant ties and to improve the distribution system. Waverly seems set for some time to come.

### What Did They See?

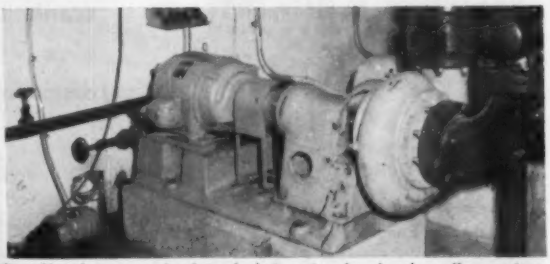
Most of the visitors to the open house didn't know beans about diesel engines. But they did know that they had something good going for them and were interested enough to come down and see what was going on.

They saw an engine of imposing size running quietly and with no vibration. There were displays and sectional charts to help those who were technically-minded to understand some details of design and construction.

They could talk to and ask questions of Enterprise people, both from the factory and the Enterprise representatives who handled the installation—Power Equipment Company of Kansas City. Or they could talk to Victor Etem, president of Associated Consultants, Minneapolis, the consulting engineering firm on the job.

Finally, they saw their city officials, from Mayor deNeui on down, and Merritt Bushby, superintendent of Municipal Utilities. They could get at first hand the thinking of the group responsible for insuring continuance of the utility's service to the community. Also, they could see for themselves how these plans were made a reality.

In short, they could see that Waverly was sitting pretty and that its residents could really be proud of their Municipal Electric Utility.



*Centrifugal pumps circulate jacket water in closed cooling system.*

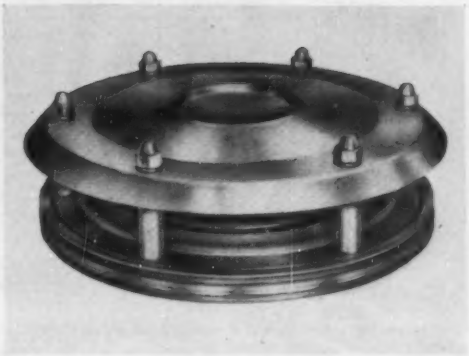
*Two coolers shown provide low-temperature aftercooler water for all engines. Exhaust silencers are in line and a little above engine.*

### List of Principal Equipment

| | |
|---|---|
| Engine | Enterprise Engine & Machinery Co. |
| Injection Equipment | Scintilla Div., Bendix Aviation Corp. |
| Governor | Woodward Governor Co. |
| Turbochargers & Aftercoolers | Brown-Boveri Corp. |
| Generator & Exciter | Elliott Company |
| Air Filters | Air Maze Corp. |
| Intake Silencers | Kittell Muffler & Engineering Inc. |
| Exhaust Silencers | Maxim Silencer Co. |
| Fuel Oil Filters | Winslow Engineering Co. |
| Fuel Oil Transfer Pumps | Viking Pump Co. |
| Lube Oil Filters | The Hilliard Corp. |
| Lube Oil Strainers | Air Maze Corp. |
| Lube Oil Pumps | Viking Pump Co. |
| Lube Oil Coolers | Ross Heat Exchanger Div. American Standard |
| Jacket Water Radiators | Arrow Industrial Mfg. Co. |
| Jacket Water Pumps | Gould Pump Co. |
| Cooling Towers (Aftercooler Water) | Dover Cooling Tower Co. |
| Lube and Water Temperature Controls | Amot Controls Corp. |
| Safety Controls | Amot Controls Corp. |
| Pyrometer | Illinois Testing Laboratory, Inc. |
| Thermometer | Diesel Plant Specialties Co. |
| Gauges | Rochester Mfg. Co. |

# Crankcase Explosions Need Not Be Serious

**By G. M. Lund, Director of Engineering**
**Hoerbiger Corporation of America, Brooklyn, N. Y.**



**Investigations requested by many European diesel engine builders led to development of a crankcase safety valve that is effective in eliminating the serious results of crankcase explosions.**

OCCASIONALLY, one hears of a crankcase explosion with serious results. In recent years, these have been less frequent as their causes and cure are better understood.

With properly-designed protective equipment, reasonably good engine maintenance and better understanding of the phenomena, there is no reason why the danger of damage caused by crankcase explosions cannot be eliminated entirely. It is with this in mind that this discussion of the general subject was prepared.

Our investigations were undertaken at the request of several well-known European diesel engine builders and this led to the design of a crankcase safety valve to be described. Since it is not practical to go around causing crankcase explosions, special test equipment had to be devised. It was also necessary to investigate flow resistance of different valve designs with and without numerous types of flame traps.

Detailed reports on the findings of various investigators have been published. Thus, it will only be necessary to outline some of the major facts on which they all agree.

### The Nature of Crankcase Explosions

Ignition of oil air mixtures in the crankcase is practically always caused by local overheating. Some part is not functioning properly and gets too hot. This emphasizes need for good engine maintenance.

Intensity of the explosion is determined by different factors. For example:

1. Distribution of oil fog in the crankcase.
2. Degree of concentration with respect to available air.
3. Number of safety valves and total valve area.
4. Design and installation of the safety valves.
5. Volume and design of the crankcase.

Pressure developed by initial explosion is in the range of from one to two atmospheres as the conditions suitable for ignition generally exist only in a limited area. Principal danger lies in rupture of the engine structure that permits additional air to enter for support of combustion. Secondary explosions are generally of greater intensity and thus more dangerous.

Primary explosions can usually be resisted, providing that the crankcase safety valves release pressure quickly and close immediately. This prevents an inrush of air and thereby secondary explosions, often disastrous.

### Safety Valve Design

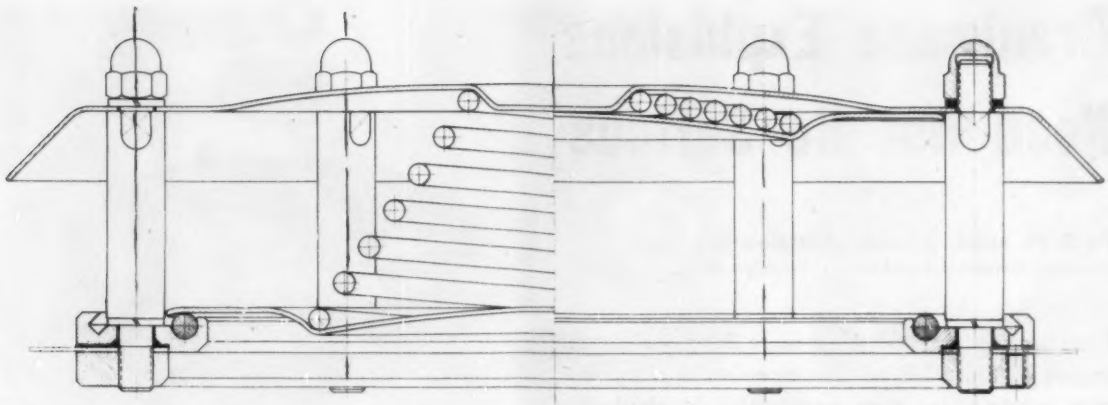
To test various valve designs, a special explosion vessel was used. Propane/air mixtures were ignited by a jet igniter. Provision was made for control and for measuring pressures at different parts of the vessel. Duration of pressure waves was also measured. Explosion gases flowed through the safety valve to the atmosphere.

Early tests showed the importance of good aerodynamic design to get low flow resistance of the valve. Design characteristics and operation of several valves were evaluated and after preliminary screening, the design to be described was tested with the explosion vessel.

This safety valve is shown in cross section, both open and closed. It consists of an annular valve seat, bolted or welded to the crankcase door, a valve guard, a spring and a valve plate. Spacer bolts support the guard and also guide the valve plate during lift.

The valve plate seats on an oil- and heat-resistant nylon o-ring as shown. Both this plate and the valve guard were formed, not only with aerodynamic considerations in mind, but to form seats for the conical spring. This spring is fairly light and with its larger outer diameter, not very stiff. Moderate flow pressure is adequate to open it completely. Note spacing of the coils to avoid jamming.

Note also that there are no ribs or supporting members in the valve area. Flames and gases have free passage until they hit the guard that acts as both shock absorber and flame guide.



*Hoerbiger crankcase safety valve is seen closed at left with valve resting on O-ring seal and spring expanded. At right, valve fully open, has flattened spring against guard so escaping gas has clear, smooth access to atmosphere. Guard deflects flame along side of engine.*

During tests it was found that what might be considered minor aerodynamic changes caused significant effects. This is, of course, important in relieving pressure quickly.

The valve tested had a clear opening inside the seat of 128.65 sq. in. Diameter at the sealing ring was 13.455 in. giving an area of 147.25 sq in. Free valve lift was 3.54 in. Spring force was 82.5 lb closed and 127.6 lb fully open. Pressure needed to move the plate was 0.56 psi.

Flow begins immediately with unseating of the valve and increases rapidly to maximum at full valve lift. The seating ring of the first valve tested was of general octagonal section with square corners. A flow resistance value around the seat at maximum valve lift was determined at 6.5 whereas the value in free-flow areas was only 3.5.

Although overall flow was acceptable, some seat edges were beveled and resistance values in the seat area were lowered about 15%. Further rounding of all edges reduced the first measured value by 65% at maximum lift. Improved aerodynamic design of o-ring seal further improved flow losses by 10%.

Investigations as to the effect on flow of flame traps, both inside and outside the crankcase, were also made. Brass and copper 12-mesh gauze was used in from one to three layers. Installed externally, the effect on flow with a single layer was only 3 to 5%. Three layers doubled the effect.

Mounted internally, flow resistance was more than twice that for a valve without flame traps. It is felt that the increase in resistance in both cases is not the result of throttling but of turbulence caused by the wire mesh. The effect was evidently amplified with internal mounting.

Testing also included a check on the valve's reliability. Also, its durability. Explosions of different intensity from 1.7 to 2.3 atmospheres and duration from fractions of a second to a few seconds were propagated in the explosion vessel. After repeated exposure to these detonations, there was no damage to the safety valve. It closed immediately after each pressure release and sealed perfectly.

Explosion flames of a foot and one-half were measured. It was clear that the flame guard was effective in limiting the range of the flame and also in directing it along the side of the engine. This minimizes danger to personnel and cuts fire risks.

## Summary

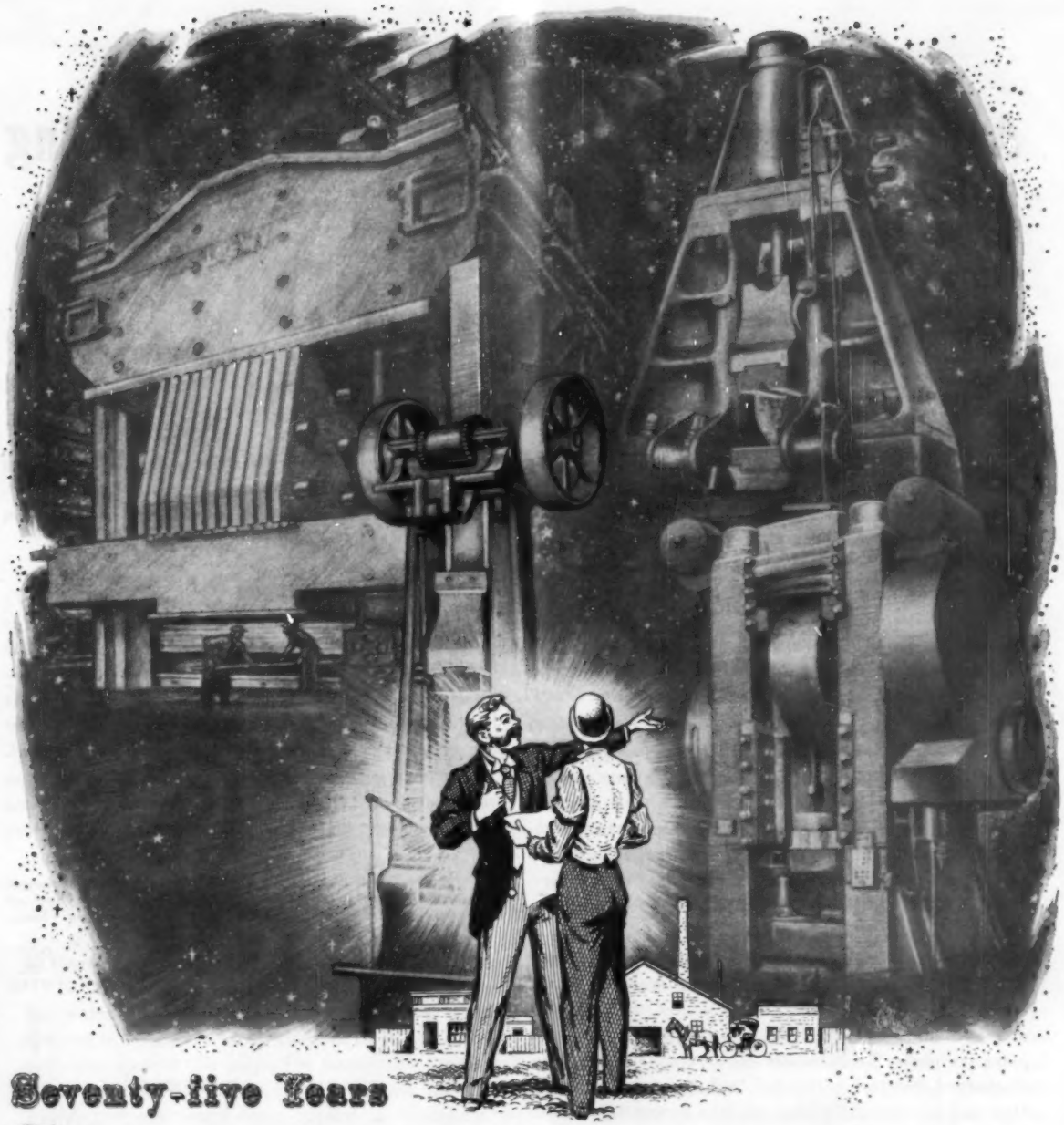
It is evident that noticeable crankcase explosions very seldom occur because several distinct conditions must be present. Chances are very remote that all conditions will exist simultaneously and produce a really violent primary explosion.

Good maintenance is effective in eliminating explosions as ignition of the oil/air mixture is usually due to some malfunctioning part that caused a local hot spot. If such a condition is suspected, a wise precaution is to let the engine cool before opening the crankcase and thus admitting air. Inspect crankcase relief valves. Don't paint over them, block them or do anything else to prevent them from functioning.

Explosions that do occur can usually be resisted by the engine structure, particularly with the aid of crankcase safety valves. The safety valve should be reliable, release pressure quickly and close immediately. This prevents the inrush of air which if it occurs, as in the case of a ruptured door or stuck valve, results in a secondary explosion, often disastrous.

Finally, the design of crankcase relief valves should be adequate. One standard on which to compare the effectiveness of a crankcase safety valve is the requirements of the marine classification societies — American Bureau of Shipping, Lloyd's Register, Bureau Veritas, etc. Even here, requirements range from 1 sq in. of valve area for from 1 to 2 sq ft of crankcase volume.

The particular valve described reduces pressure rapidly. It has demonstrated ability to meet the most stringent requirements of the classification societies and is approved by them.



# Seventy-five Years

THERE WAS a growing surplus in the United States Treasury—the Polygamy Act was passed—letter postage was reduced from three cents to two cents—the Brooklyn Bridge was opened—standard time was adopted—in 1883, when two young men, just graduated from Worcester Polytechnic Institute, established the business bearing their names—WYMAN-GORDON. The total capital was $27,000.

Integrity, initiative, ambition and ability were theirs. Endowed with these qualities and privileged to operate under that unique American system of free, private, competitive enterprise the Company prospered and grew.

On this our 75th anniversary, we salute the spirit of our founders and we pledge our every effort to help preserve, against the steady erosion of the last quarter century, that system which has made our nation what it is today and which has enabled us to build the greatest industrial production in the world, resulting in the highest standards for all segments of our people.

## WYMAN-GORDON COMPANY

ESTABLISHED 1883

FORGINGS OF ALUMINUM • MAGNESIUM • STEEL • TITANIUM

HARVEY, ILLINOIS | WORCESTER 1, MASSACHUSETTS | DETROIT, MICHIGAN

# A New Concept for Residual Oil Conditioning

**A modified self-cleaning centrifuge design and a water-phase recycle system, ingeniously combined, offers advantages for conditioning residual fuel for diesel engine use.**

THERE'S a precept in architecture that says "form follows function". This idea that the shape of something depends on the job it's to do can be borrowed and applied to a new development in centrifuges.

The company involved is the Sharples Corporation. The centrifuge that has benefitted from this research development is the self-cleaning "Nozljector" machine. These units have broad application in a large number of industries as separators and clarifiers—including vegetable oils, animal fats and, of course, petroleum products.

In the long range program to increase effectiveness of the Nozljector, new ideas have been developed and integrated into the design, which have been further covered by patent applications. Results apply to a wide range of materials, but will be discussed here in reference to cleaning of the heavier fuel oils. In general, performance has been improved, capacities increased, and certain objections to the conventional self-cleaning and recycling systems have been eliminated.

There have been basically two conventional arrangements for continuously purifying heavy fuel oils. Using a clarifier-type bowl, solids, water, sludge and some oil are continually discharged through nozzles in the bowl's outer periphery. To minimize oil loss, a portion of this discharged material is recycled back through the centrifuge and is continually bled off in a concentrated form for disposal (See Fig. 1.).

This type of system has limitations insofar as the quantity of water in the crude that can be handled, and since concentration of the discharged sludge is limited by physical capacity of the recycle system, the sludge contains reasonable large amounts of burnable oil.

The alternative to the clarifier bowl has been the standard nozzle-type separator bowl (Fig. 2.) which has hydrostatically balanced oil and water layers. This type of bowl discharges a water stream through the nozzles and reduces loss of oil in the sludge to a minimum. However, a relatively shallow oil layer must be maintained in the bowl. This sharply reduces bowl capacity and ability of the bowl to break difficult emulsions. In addition, control of this shallow oil layer has been troublesome.

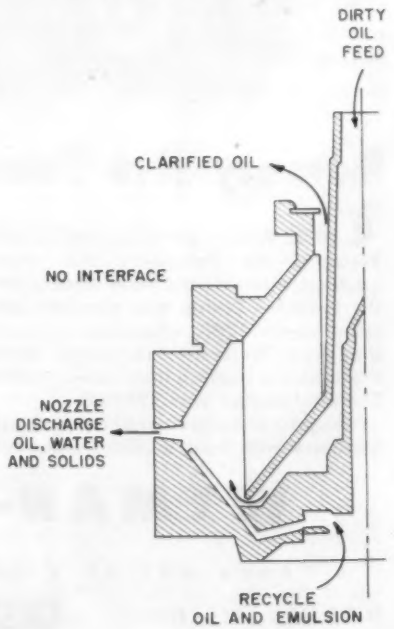
Objectives in the new Nozljector were to overcome limitations imposed by these systems and to improve overall performance, and broaden application. The question was how it was to be done.

## A Look at the Centrifuge

Let's review a few facts about a centrifuge. First, it is sensitive only to differences in specific gravity of the materials being separated. In cleaning fuel oils, the materials to be removed are basically solids and water. As the result of centrifugal force applied, higher specific gravity materials are forced to the outside of the bowl.

Effectiveness of contamination removal depends on many variables. Time is one factor. Everything else being equal, the longer the residence time in the bowl, the more

*Fig 1. Conventional nozzle-type clarifier bowl. Part of discharged material is recycled back through bowl and is continually bled off in increasingly concentrated form. This minimizes oil losses.*



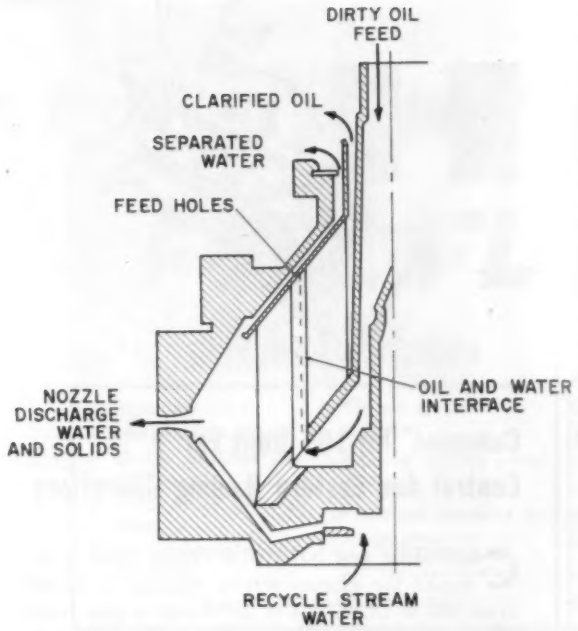



*Fig 2. Conventional nozzle-type separator bowl has hydrostatically-balanced oil and water layers. Oil layer is shallow, sharply reducing bowl capacity and limiting ability to break emulsions.*

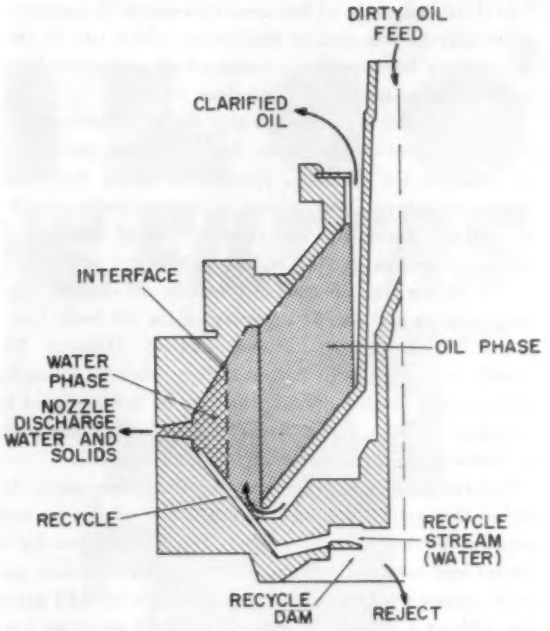



*Fig 3. Hoxljector Gravitrol bowl has adjustable recycle dam, limiting recycle water to that needed to hold interface location constant for greater bowl capacity and emulsion-breaking.*

complete the cleaning job. But when time is stretched out, through-put capacity of the centrifuge is reduced.

Magnitude of centrifugal force is another variable. There is a practical limit to rotative speeds, but the radius of action can be changed. Take the case where water is being separated from oil. Depending on the adjustment of dams in the centrifuge and the relative specific gravity, an interface between the oil and water will be formed somewhere in the bowl.

The position of this interface governs depth of the oil and water layers in the bowl, and the amount of force that can be applied to break stubborn oil and water emulsions that form at this point. The farther this interface is from the center line of the centrifuge bowl, the greater will be the centrifugal force applied to emulsions, the deeper will be the oil layer in the bowl, and the greater its residence time.

The big payoff is that although centrifugal force is directly proportional to the radius of the interface, the actual separating capacity is roughly proportional to the cube of the radius! For example: Say that the radius is increased from six to nine inches by changing interface position in the centrifuge. Six cubed is 216. Nine cubed is 729. So, for a 50% increase in radius, efficiency increases 338%. The result is obviously more complete and/or faster separation of materials having different specific gravities.

Other variables include the relative specific gravities of the materials, length of path contaminants must travel before leaving the oil, and viscosity of the oil. Where specific gravities of the oil and water are very close, a greater differential can be maintained by the addition of a solvent to the oil to change its specific gravity, or by addition of various water soluble salts to increase specific gravity of the water. Length of path is principally determined by bowl and disc stack design. Oil viscosity can be controlled within limits by suitable heating.

## Working Out an Improved System

Attainment of the desired objectives was developed along the following approaches: First, the position of the interface would have to be moved beyond the edge of the disc stack. This would materially increase centrifugal force at the interface and permit utilization of the full disc stack for clarification of oil. Second, water would be used as the recycled fluid. This would remove limitation on the amount of water in the oil feed that could be handled, further reduce the oil losses and solve the disposal problem.

The concept would be a dual-phase system consisting of an oil phase and a water phase with contact only at the interface through which contaminants would be transferred. For consistent results, the location of the interface would require close control.

Since the nozzles in the bowl periphery discharge a fixed volume of water and contaminants, some provision was required to compensate for variations in amount of water in the oil feed which would alter position of the interface. Changes in specific gravity of the oil would also alter this position. Fig. 3 shows the successful solution.

The clarifier-type bowl has been redesigned to include an adjustable recycle dam at the bottom which can be sized to maintain hydrostatically balanced oil and water layers in the bowl at the desired interface location.

Action of this dam is such that the bowl accepts only that quantity of recycle water, less, of course, the amount of water in the oil feed, which will satisfy the nozzle discharge volume. Any excess is automatically rejected. Interface position remains fixed, provided there is no change in specific gravity of the oil or water layers.

The recycle dam selected is based on the desired interface position and the API gravity of the oil feed. Under practical operating conditions, oils of different API gravity may be fed to the centrifuge, thereby changing the interface position. While this can be compensated by changing the dam, this is a time-consuming job and highly impractical. So a further refinement is used.

Specific gravity of water varies with temperature. Applying this principle to the recycle water phase, its temperature is raised or lowered as the specific gravity of the oil feed varies. In this manner, interface location can be maintained over a spread of four to five oil API gravities without a change of dam. If oil API gravities vary beyond this spread, a change of dam is necessary.

**Results**

Ability to move out the oil-water interface and maintain a precise location produces a number of favorable results.

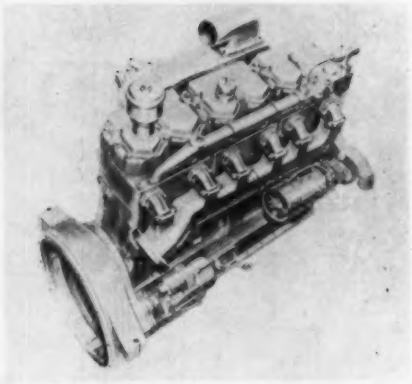
1. More centrifugal force is made available for clarification of the oil and for breaking up of emulsions. Because the whole disc stack is utilized for purification of the oil phase, centrifugal separating efficiency is vastly increased. This reduces necessary residence time and increases the centrifuge's capacity.

2. Solids (contaminants) removed from the oil and carried by the recycle water are oil-free and readily settle in the recycle water system. Disposal offers no problem. Only an occasional removal of sedimented material from the recycle water system is required.

3. Specific gravity control of the recycle stream through simple temperature regulation maintains a high clarification effectiveness by holding interface position substantially constant.

Wide variations in the volume of water in the oil feed can be readily handled. In fact, feed to the centrifuge can be turned on or off without upsetting the recycle system. Compensation is also made, within limits, for changes in the API gravity of the oil.

This new Nozljector system, which has been covered by patent applications, has been applied in numerous industries to handle various types of oil—animal, vegetable and mineral. Reports indicate clarification as good if not better than conventional systems, with multifold increases in capacity and elimination of the many previously encountered troublesome characteristics. For cleaning and purifying heavy fuels oils, these are real advantages.

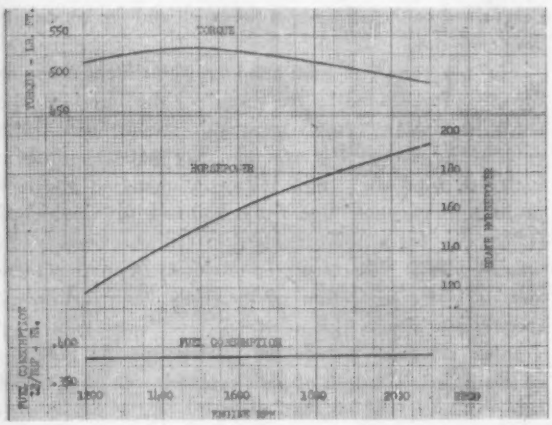


## Cummins' NH-195 Built For Central And Eastern Hauling Operations

CUMMINS' new NH-195, a 195-hp diesel is designed for express service hauling of 55,000 to 60,000 lb GCW. It was developed to give truck operators an engine between 180 and 220 hp with the lowest average fuel consumption per ton-mile of any engine in this range. It is said to meet the higher horsepower demands of operators in Central and Eastern U. S. In this area, revised weight and length laws permit greater payloads and new toll and express highways permit higher speeds.

Basic components of the NH-195 are the same as those of the Cummins NH-220 and recently-introduced NH-180. It is rated 195 hp at 2100 rpm. It has a 4⅞-in. by 6-in. bore and stroke, 672-cu in. displacement and 535-ft lb peak torque.

Like the NH-180 and NH-220, the NH-195 features wet-type liners, Cummins PT fuel injection system and a 4½-in. diameter crankshaft. Two intake and two exhaust valves provide easy breathing for complete fuel combustion. The rugged NH series engines are reported to give 300,000 to 350,000 miles of service before and between overhauls.



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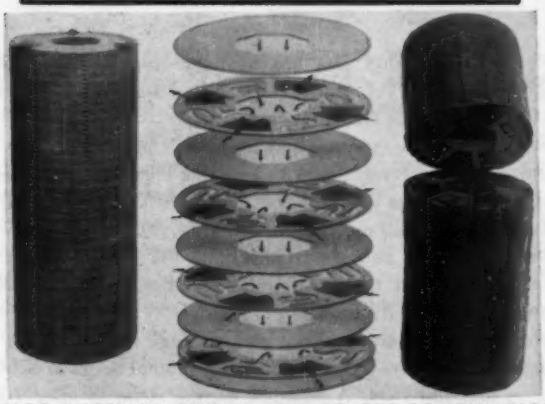

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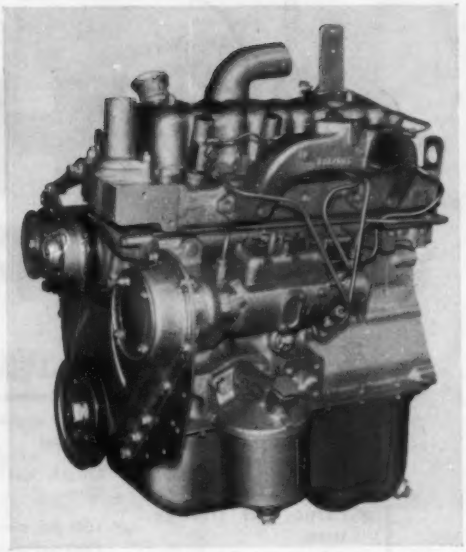
# Perkins' "Four 99" Diesel

**Development of Perkins' "Four 99" engine successfully used in European cars, taxis and light trucks, all smaller than the average American types, suggests re-examination of the thinking that diesels are only for use in large commercial vehicles.**



*Fuel pump side of "Four 99", 4-cyl, 99-cu in. diesel.*

PERKINS' new "Four 99" diesel is aimed right at the light truck, taxicab and automobile market. By "light" is meant vehicles in roughly the 2000 to 4000 lb gross weight range. It combines the gasoline engine's speed and flexibility with the diesel's ruggedness and economy.

There is wide acceptance abroad of diesel power for vehicles well below the weight and horsepower of the average American automobile. The major incentive is economy. Invasion of the American market by light foreign utility sedans, station wagons and miniature trucks would indicate that the economy motive is getting stronger here.

Current thinking here is in terms of diesels for vehicles of 19,500 lb GVW and up. Yet here is an engine that by its specifications and performance shows that it is at least technically feasible to use diesel power in vehicles below current domestic automobile size—with economy.

It took F. Perkins, Ltd. of Peterborough, England, six years of research and testing to develop this 4-cycle engine. It is now available to prospective purchasers for evaluation purposes. Canadian representation is F. Perkins (Canada), Ltd. in Toronto. Continental Diesel Corporation, Brooklyn, N. Y. are their agents in this country.

### Performance Testing

Cars, trucks and taxis powered by the "Four 99" have piled up over a million road miles. Installations have been made in the Vauxhall Velox and Wyvern, Morris Oxford, Simca Versailles and Airiane, Mercedes-Benz 180D and Ford Consul. Also, in Austin, Bedford and Standard light trucks and the Beardmore Mark 7 taxis.

Conversion sets are available for the Ford Consul, Vauxhall Velox and Wyvern and for a Bedford, Austin and Morris truck.

In tests, cruising and top speeds proved equal to those of similar vehicles with gasoline engines. Some cars did better than 80 mph. A Vauxhall Velox averaged 56.6 mpg at 34.8 mph; a Ford Consul, 50.8 mpg at 34.7 mph. A 15-cwt Bedford truck completed 101,202 miles on a high-speed track, lapping consistantly at 56 mph and averaging 37 mpg.

Test results promise high mileage without major overhaul. In one test a "Four 99" ran 3000 hours at 3000 rpm and full load. A field-test engine stripped after 100,000 miles showed all major components to be in perfectly serviceable condition. Bore wear was 0.001-in. per 20,000 miles.

An industrial version of this engine is designed for lighter types of fork-lift trucks, compressors, generators, dumpers, pumping sets and cranes. It can be easily installed in many kinds of equipment now powered by gasoline engines.

### Engine Features

The "Four 99" weighs 320 lb. It is a 4-cycle, 4-cyl unit. Bore is 3-in., stroke, 3.5-in. Displacement is 99 cu in., hence the name. Compression ratio is 20:1. Rating data is shown.

Engine features include a new patented combustion system, new fuel injection pump and advances in bearing design. The combustion system was specially designed for this engine.

The upper part of the chamber is hemispherical in shape and is machined into the cylinder head. The lower

half is formed by a machined insert. This contains the throat or oval port connecting the chamber to cylinder. Fuel is injected into the chamber by a pintle-type nozzle.

During compression, air is transferred into the chamber vertically upwards through the oval port. It produces a swirl moving transversely across the nozzle. Later, direction of air transfer gradually changes from vertical to horizontal.

When combustion is about to begin, the final portion of air is transferred violently and enters the combustion chamber horizontally to promote turbulence in the air-fuel mixture already present. This promotes complete combustion by maximum use of the air present.

A new C.A.V. Model DPA distributor-type fuel pump is designed for trouble-free operation at speeds over 4000 rpm. Its inertia masses are very small. Variable timing, advantageous at the high engine speeds, is achieved by hydraulic means.

This pump is the C.A.V. version of the RoosaMaster Model A pump, built by C.A.V. through agreement with Hartford Machine Screw Company. Operating principles are the same as those of the RoosaMaster pump.

To permit variable timing, the cam ring is movable. A cam ring projection has a spring on one side and a hydraulic plunger, actuated by fuel pressure, on the other. At higher speeds, fuel pressure increases, thus slightly turning the cam ring in relation to the pump casing against spring pressure. This starts the delivery stroke earlier, advancing injection timing.

Engine speed is controlled by a hydraulic governor on vehicular engines and by a mechanical-type unit in industrial models.

*The cylinder block* is cast integrally with the crankcase. Centrifugally-cast iron wet liners are fitted to this block.

*The cylinder head* also is of heavy-duty cast iron. Valve rocker gear is mounted on the cylinder head and enclosed by a pressed steel cover.

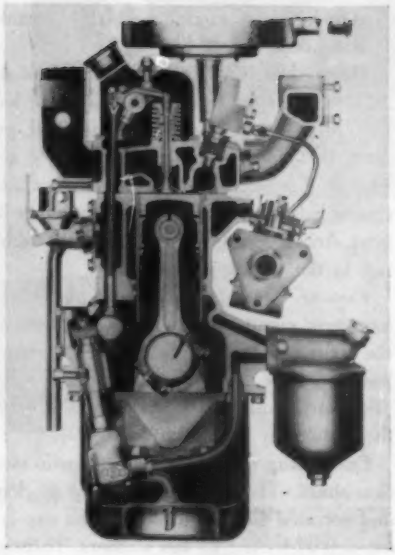
One inlet and one exhaust valve per cylinder are provided. Two springs, retained by a hardened cap and split conical keepers, are provided for each valve.

Valves are operated by cast iron, mushroom-type tappets through push rods and rocker arms. Tappet adjustment is made by hardened ball-ended adjusting screws and locknuts at the push rod end of the rocker arms. Rockers and valve gear are lubricated by an intermittent feed, taken from the center camshaft bearing to the hardened hollow rocker shaft.

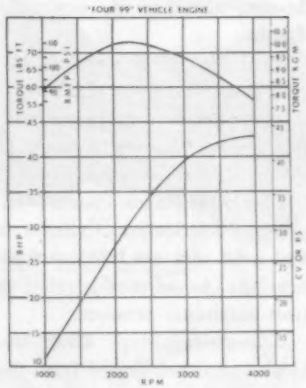
*The camshaft* is of heavy-duty cast iron. Cams are chill-hardened. It is mounted low on the cylinder block in three bearing bores machined directly into the block. The front and center bearings are pressure lubricated, the rear one is splash-lubricated, as are the cams.

*The crankshaft* is forged from chrome molybdenum steel and includes four integral balance weights. It is drilled for pressure lubrication of the pins. Pin and main journals are induction hardened.

*Three main bearings* are provided. These are of the thin-wall, pre-finished, steel-backed, lead bronze-lined

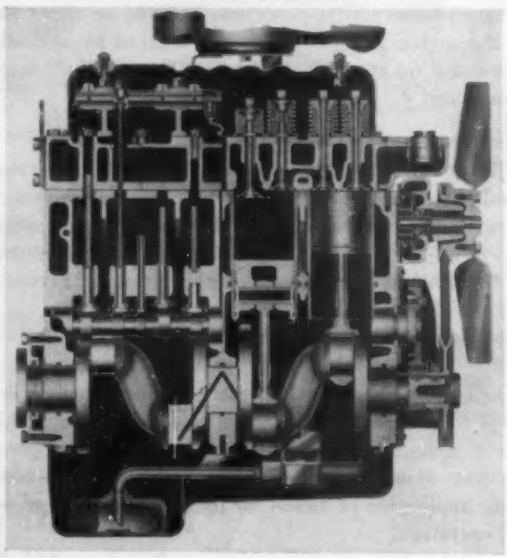


***Section through Perkins "Four 99". Note pintle type nozzle in new combustion chamber. Port in combustion chamber insert connects it to cylinder. C. A. V. version of Roosa-Master fuel pump is seen above lube oil filter.***




***Performance curves of "Four 99" vehicle engine. Maximum torque is hit at 2250 rpm and maximum bmep of 111.2 psi.***

***Short engine and rigid crankshaft permit 3-bearing design. Arrangement and design of other engine parts are also seen.***



type. The short engine and rigid crankshaft permit 3-bearing design.

Heavy-duty cast iron bearing caps are held by two high-tensile steel cap-screws. Caps are located by dowels.

*Timing gears*—Camshaft and fuel pump are driven from the front of the crankshaft by a steel crankshaft gear and idler. Helical teeth reduce noise. Fuel pump timing adjustment is provided by slots in the fuel pump gear. Access to this adjustment is through a covered opening in the timing case.

*Pistons* are of high-silicon aluminum alloy. Each has three compression rings and one scraper ring above the wrist pin and one scraper ring below. The top compression ring is chromium plated for practically all applications. Full-floating wrist pins are located axially in the pistons by spring clips.

*Connecting rods* are of high-tensile steel with "H" section shank. The big end split is at 45 deg to the rod axis and serrated for cap location. The cap is secured by two cap-screws locked by tab washers. Thin-wall, pre-finished, steel-backed lead bronze-lined big-end bearings and lead bronze, steel-backed, wrapped small-end bushings are fitted.

In the lubricating system, an oil pump, located in the pan, is driven by spiral gears from the camshaft. A strainer is provided at the pump inlet. Oil is delivered through a full-flow filter to a main gallery drilled lengthwise through the crankcase.

Branch passages conduct oil to all points receiving pressure lubrication. Cylinder bores, small-end bushings and wrist pins are lubricated by splash from the big-end bearings. An adjustable relief valve in the oil pump controls maximum pressure.

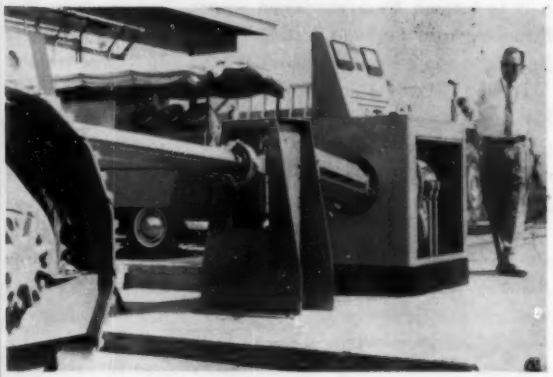
A centrifugal-type water pump fits in the cylinder block and is belt-driven from the crankshaft. Provision is made on the water pump pulley for driving a fan.

Twelve-volt electrical equipment is used. The generator is belt-driven from the front end of the crankshaft. The flange-mounted starter motor can be fitted on either side of the engine. The starter ring is engaged by a Bendix drive. To aid starting, A C.A.V. "Thermostart" heater is mounted in the intake manifold.

### Summary

Though comparable in size and weight with equivalent gasoline engines, the "Four 99" retains the heavy-duty features normally associated with diesels. Engine speeds and flexibility are equal to gasoline engine performance as evidenced by tests of vehicular applications. Economy and durability, of course, are superior.

Acceptance and use of such engines abroad for vehicular application—in vehicle sizes below common American types—shows that there is little size limit imposed by diesels. Performance is reasonably comparable. The economics must be studied and with current operating costs mounting, a long, close look should be taken at the application of diesels for light vehicles in commercial operation.



## Tractor Engines Power-Proved Right In Place

YOU can now power-prove a diesel right in a tractor. Clayton Mfg. Company's new PTO dynamometer permits you to do this without removing the engine from the chassis.

The unit is essentially an engine dynamometer with a PTO coupling and an intermediate support which is adjustable to height variations of a PTO. It permits testing of tractor engines rated up to 450 hp and 1800 lb ft torque at the PTO.

The unit accommodates tractors equipped with mechanical transmissions or torque converters. It handles equipment having PTO shafts from 17 to 51-in. above floor level and allows for testing tractors positioned up to 6-in. on either side of the dynamometer center line.

It is reported that virtually all U.S. tractors and other diesel-powered construction equipment with PTO shafts can be tested on this unit. Four PTO adapter plates provide easy coupling for almost all popular tractor models.

When a Clayton universal engine test stand is connected to the other end of the PTO dynamometer, the entire assembly provides a complete installation for testing basic engines, power units, tractors, and heavy-duty rubber-tired construction vehicles equipped with a PTO.

A standard or heavy-duty drive shaft can be used to connect the intermediate support shaft flange to the dynamometer flange. The former has a torque limit of 1800 lb ft, the latter, a torque limit of 2600 lb ft. Heavy-duty drive shaft flanges are needed when using the latter.

A PTO drive coupling and bushing connects the end drive assembly to the tractor transmission shaft. Only the coupling is required on 2.52-in. diameter tractor shafts, or greater. For smaller shafts, both coupling and bushing are required.

## Unique packing retention method eliminates test rings

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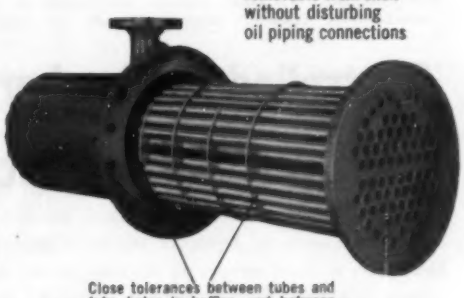
Exclusive "retainer ring" design, available only in Paracoil "PC" Exchangers, **permits shell side pressure test with bonnet removed. No auxiliary equipment or special devices are required to hold tube sheet packing against pressure.** By backing off only one set of nuts, bonnet may be removed without displacing packing or retainer ring. Pressure may be applied to shell side to test for defective tubes or leaking tube joints. With bonnet off, retention studs hold retainer ring and packing in place.

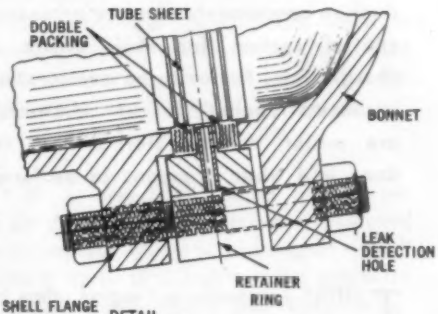
Leak detection holes in retainer ring show leakage from either tube or shell sides (See detail below).

Tubes may be tested, re-rolled, even replaced, without removing tube bundle from shell.

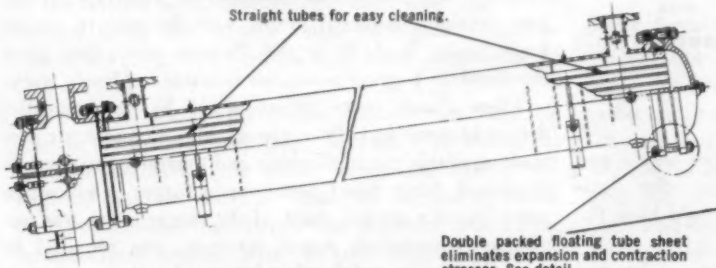
Tube bundle easily removable from shell without disturbing oil piping connections



Close tolerances between tubes and tube holes in baffles, and between baffle periphery and shell, assure maximum heat transfer.




DETAIL — Section thru floating tube sheet showing packing and detection hole in retainer ring.



Straight tubes for easy cleaning.

Double packed floating tube sheet eliminates expansion and contraction stresses. See detail.

Wide selection of materials as dictated by service requirements.

Standard commercial, ASME or Marine Code construction.

**HOW IT WORKS**

**Mixing of shell and tube side fluids due to packing failure is impossible in this Paracoil Type "PC" design.** Any leakage from either side, resulting from loosening of bolts or worn packing, escapes through the detection holes. The operating personnel is thus on notice that servicing is required.

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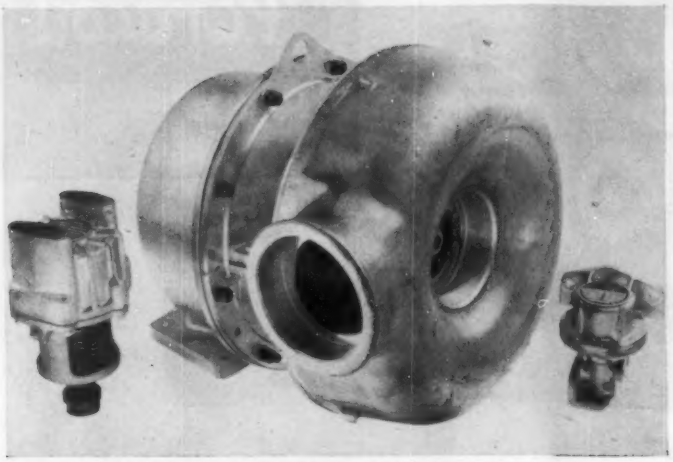


*AiResearch turbocharger is shown with units making up pressure-ratio control system. Exhaust by-pass valve is at left of turbocharger. Pressure-ratio sensor is seen at right of turbocharger.*

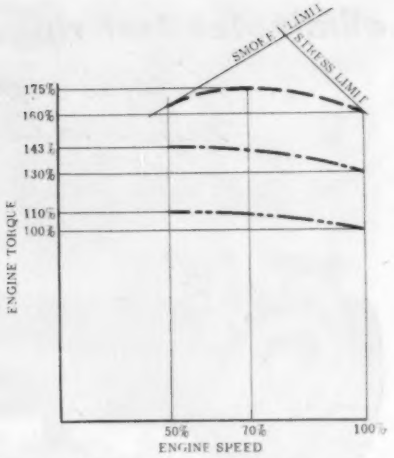



*Fig 1. Typical torque curves for (bottom) naturally-aspirated engine; (center) mechanically supercharged engine and (top) conventionally turbocharged engine. Shape of top curve is a compromise governed by operating limits, here shown as the typical smoke and stress limit lines.*

# Controlled Turbocharging Improves Performance

**Garrett Corporation's AiResearch Industrial Division has developed and put into production components of a new pressure boost control system for their entire turbocharger line. Faster turbo acceleration and improved engine torque characteristics are major results. Here's how it was done and what it means in performance.**

TODAY's turbocharged engine offers high output and efficiency. Naturally-aspirated engines offer flexibility. Combine these characteristics and you'd have the current ultimate in diesel working power.

This combination of power advantages has now become a practical reality with a turbocharging system that is boost pressure controlled. Components of the system are now in production at The Garrett Corporation's AiResearch Industrial Division, Los Angeles. Units have already acquired extensive operational experience and are standard production items on some Caterpillar Tractor Company equipment.

Developed for use with the entire family of AiResearch turbochargers, the boost pressure control system provides two basic types of improvement over previous turbocharging methods. Improvements are accomplished by controlling speed and acceleration of the turbocharger.

First, improved turbo acceleration provides better engine response or snap and reduces exhaust smoke when under heavy load. Second, improved torque characteristics provide greater peak horsepower, greater engine lugging ability for heavy work with minimum gear shifts, together with reduced engine stress levels.

## Why "Controlled Turbocharging"?

We can best understand the gains realized from this new development called "controlled turbocharging" by briefly tracing progress of the supercharged diesel.

Power developed by the naturally-aspirated diesel (lowest torque curve on Fig. 1) is limited by the amount of air it can breathe for combustion. This type of engine develops increased torque with decrease in engine speed under load. It is this "torque rise" that gives the diesel its lugging power, so valuable for heavy work.

When diesels were supercharged by mechanically-driven blowers (middle curve on Fig. 1) more air was made available for combustion and thus more power was developed. Since this type of supercharger is a positive pump like the engine, shape of the torque curve was unchanged. Crankshaft power, however, was required to drive the blower and this fact increased fuel consumption and limited available engine power.

The modern turbocharged diesel utilizes a more efficient supercharging unit driven with exhaust gas energy which was formerly wasted. This device made possible both increased power and decreased fuel consumption. However, under variable speed and load conditions and when supercharged with conventional, free-floating (uncontrolled) turbochargers, engines face two operating limits which influence their behavior.

At low rpm, engine torque is limited by the decreas-

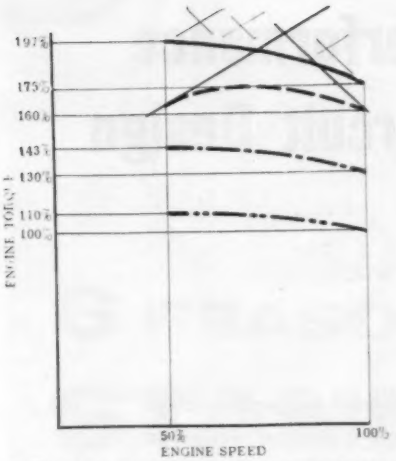



*Fig 2. Same three torque curves with addition of a torque curve (top) made possible by controlled turbocharging. By control of the turbocharger speed, smoke and stress limitations are removed. The most desirable turbocharger speed is maintained over a wide range of engine speeds.*

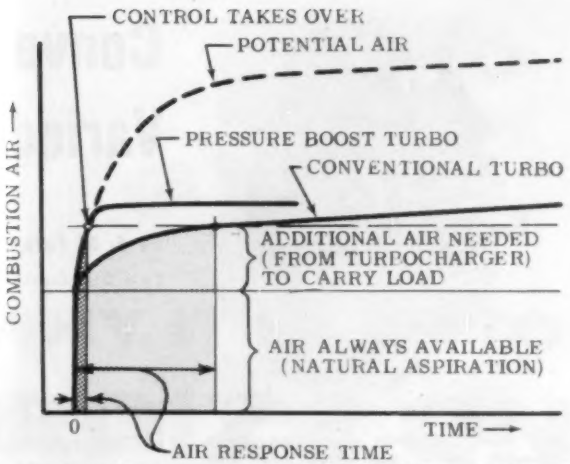



*Fig 3. With pressure boost control, the turbo's nozzle ring can be selected for quick response and maximum torque at the lowest engine speed desired. Turbo speed limitation (stress limit) is no longer a factor in nozzle ring selection as excess exhaust gas, tending to drive the turbine faster, is bypassed. This action is shown by the line labeled "Pressure Boost Turbo".*

ing combustion air available as turbocharger speed drops. This is the smoke limit example shown at the top of Fig. 1. At high engine speeds, torque is limited by the stress limit line shown. This line, a typical limit for a well-matched turbocharger and engine, represents either turbocharger speed stress or engine pressure stress. Other limit lines may be selected.

Torque curves of turbocharged engines have been worked out by compromise under these two limits. Conventional turbocharger application reduces relative lugging ability of the engine by increasing the speed at which maximum engine torque is obtained. This is also shown in Fig. 1.

The boost pressure controlled turbocharger removes these limitations on the turbocharged engine. Action of the control is to maintain the most desirable turbocharger speed over a wide range of engine speeds, as shown in Fig. 2. This removes need for a compromise of torque curve.

With this control, the engine operator can have his cake in the form of peak power and eat it as well in the form of engine lugging ability surpassing that of the naturally-aspirated engine. Thus, the controlled turbocharger combines high power and efficiency peak of the turbocharged engine with torque flexibility of the naturally-aspirated type.

## How It Works

The AiResearch controlled turbocharger system operates by a simple principle. The turbocharger is matched to the engine with a turbine nozzle of a precisely selected size to drive the turbo unit fast enough for quick response and maximum torque at the lowest engine speed desired. This directly results in optimized torque characteristics and greatly improved response.

As engine speed increases, the boost pressure control system acts to maintain desired turbocharger speed by conducting excess exhaust gas around, rather than through, the turbine.

Rapid turbocharger response to engine load changes has become increasingly important as power levels increase. The boost pressure control system provides the highest response rates yet achieved, as shown in Fig. 3. In response to an increase in engine load, a controlled turbocharger, heading toward a high potential equilibrium speed, accelerates much more rapidly than an uncontrolled turbocharger.

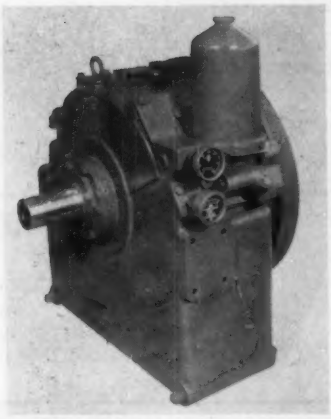
As the desired turbocharger equilibrium speed is reached the pressure control takes over and maintains this speed. Thus, the time required to develop the desired amount of combustion air is greatly decreased.

## Some Results

Caterpillar DW 20 and DW21 wheel tractors are equipped with the AiResearch boost pressure controlled turbocharging system. The system provides equal rimpull for these tractors at up to 10% higher travel speeds. In addition to more than double torque rise, improved lugging and acceleration characteristics, other benefits experienced include decreased specific fuel consumption, and reduced smoking.

Extensive tests with retrofitted installations on over-the-road truck operations have been conducted by AiResearch. Results show an average 5% increase in fuel mileage over normally-turbocharged diesels. This margin is 10% over non-turbocharged models and in individual cases as high as 21%.

It appears that this highly refined method of turbocharging will provide a substantial boon to operators of diesel engine equipment, significantly increasing the already notable accomplishments in the area of turbocharged diesel working power.



*Twin Disc 1500 Series single-stage torque converter, one of four circuit sizes. Five different impellers can be used for each.*

# Converter Performance Varied By Circuit Design

**By E. B. Falk**

**Twin Disc Clutch Company, Racine, Wisc.**

**New circuit designs have broadened the performance of the simplest types of single-stage converters to match a wide range of operational requirements.**

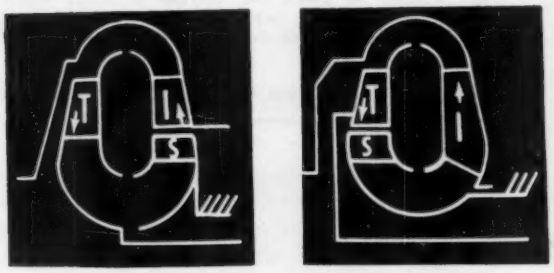



*Fig 1. Two types of single-stage circuits. Type 1 (outflow) circuit is at left. Type 6 (inflow) circuit is shown at right.*

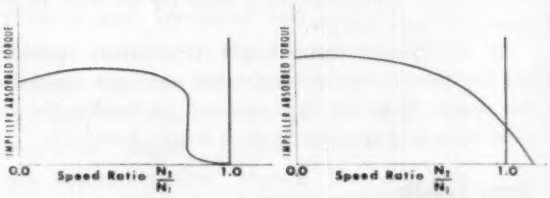



*Fig. 2. A comparison of the torque characteristics of Type 1 circuit (left) and Type 6 circuit (right). Type 1 circuit unloads engine abruptly at speed ratio of about 0.825. The Type 6 design circuit allows a no-load speed ratio of 1.15 to 1.*

TORQUE converters with high-stall torque are not always needed. For some applications, a less expensive single-stage torque converter is a more logical choice than a 3-stage type with its inherent high-stall torque capacity ranging from 4½ to 6 times engine torque. This led the Twin Disc Clutch Co., of Racine, Wisc. to add a single-stage line of torque converters to their 3-stage line.

In developing this single-stage line, a major limitation of the rotating-housing torque converter—its relatively fixed-type performance curve—had to be overcome. To eliminate this, a new design concept was developed. The same basic converter was designed with two circuits. Though essentially similar in mechanical design, it now provides two completely different sets of output performance curves.

Twin Disc engineers already had an extensive background in the design of rotating-housing fluid couplings. These use a pear-shaped circuit that produces high capacity and excellent efficiency within a relatively small

*(Continued on Page 34)*

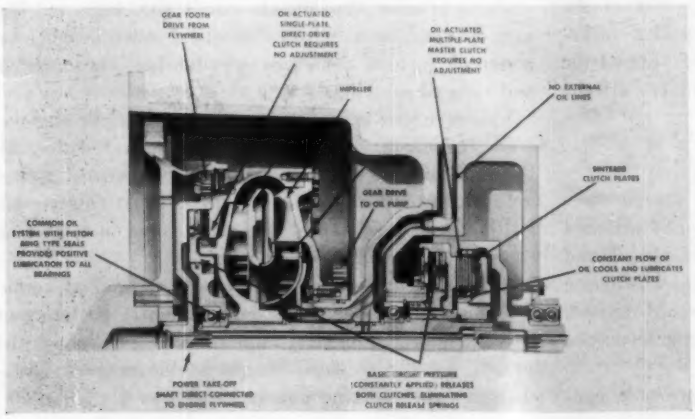
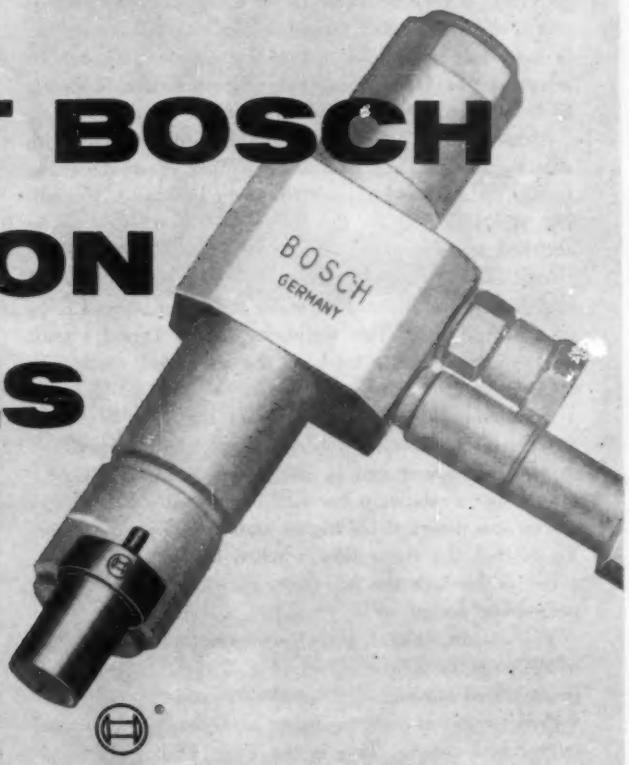

GEAR TOOTH DRIVE FROM FLYWHEEL
OIL ACTUATED SINGLE-PLATE DIRECT-DRIVE CLUTCH REQUIRES NO ADJUSTMENT
OIL ACTUATED MULTIPLE-PLATE MASTER CLUTCH REQUIRES NO ADJUSTMENT
IMPELLER
NO EXTERNAL OIL LINES
SINTERED CLUTCH PLATES
GEAR DRIVE TO OIL PUMP
COMMON OIL SYSTEM WITH PISTON RING TYPE SEALS PROVIDES POSITIVE LUBRICATION TO ALL BEARINGS
CONSTANT FLOW OF OIL COOLS AND LUBRICATES CLUTCH PLATES
POWER TAKE-OFF SHAFT DIRECT-CONNECTED TO ENGINE FLYWHEEL
BASIC CIRCUIT PRESSURE (CONSTANTLY APPLIED) RELEASES BOTH CLUTCHES ELIMINATING CLUTCH RELEASE SPRINGS

*Fig 3. Typical application of Type 1 circuit. Unloading characteristics permit impeller and turbine to be clutched together even though the stator is still in the circuit. This eliminates need of a freewheel mechanism.*

# 6 REASONS WHY IT PAYS TO STANDARDIZE ON ROBERT BOSCH INJECTION NOZZLES

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**6:** Higher quality at lower price: Sets new standards of long-life efficiency—yet actually is priced lower.

**ROBERT BOSCH CORPORATION**

Long Island City, N.Y. San Francisco, Calif.

(*Continued from Page* 32)

space package. Thus, initial design work centered around this basic circuit. However, a guide stage or stator was required for torque multiplication.

One circuit was designed to unload the engine at high output shaft speed by having the turbine develop a counter-rotational head. (See Fig. 1, left) The guide stage or stator is below the impeller so that the oil path flows in an outward direction from the center of the circuit across the stator blades. This is the Twin Disc Type-1 outflow circuit. It provides a unique primary torque curve. Primary torque is the torque absorbed by the impeller at a constant input speed while the turbine ranges from stall to full racing point.

With this Type-1 outflow circuit the engine is virtually unloaded at a speed ratio of about 0.825. (See left, Fig. 2) This condition tends to establish its own output shaft governor, a very desirable factor in applications such as power shovels. Engine torque demand at stall is relatively low, thus tending to unload the engine. This can be advantageous in engines requiring considerable power to feed oil pumps and other auxiliaries.

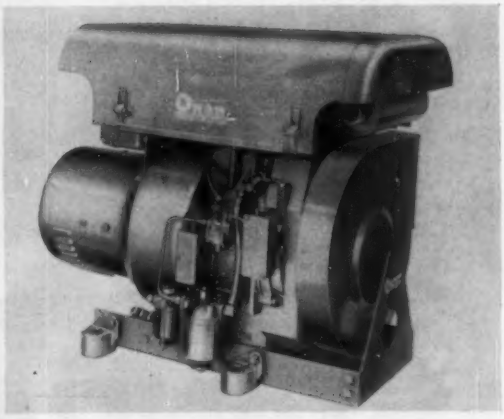
This design is particularly suitable to direct drive with a lock-up clutch. An interesting feature of what can be done with a Type-1 circuit is shown in Fig. 3. Unloading at 0.825 permits the impeller and turbine to be clutched together even though the stator is still in the circuit. Most types of rotating-type housing single-stage circuits require a freewheel under the stator when a lock-up clutch is used. This simplicity of the Type-1 circuit offers many benefits to both the user and machinery manufacturer.

Simultaneous to design work on the Type-1 circuit, another circuit was developed that extended performance at the high speed end of the curve. Since the Type-1 circuit has a relatively low stall torque ratio, the second circuit was designed for higher stall torque performance. To do this, the stator was switched from under the impeller to beneath the turbine while retaining the same pear-shape design.

This circuit, (Fig. 1, right) produced a striking change in the primary torque curve, (Fig. 2 right). The racing point moved out to 1.15:1 speed ratio and the higher absorbed torque at stall produced a moderately increased output stall torque. This is the Twin Disc Type-6 circuit. It is applicable to a broader range of machinery than the Type 1. It is especially suitable in vehicles where the high speed end of the curve can be used.

Twin Disc single-stage units permit matching the converter's absorption torque very closely to the engine's rated torque. This is done by offering four circuit sizes, the 1100, 1300, 1500 and 1800 Series and by supplying five different impellers for each size.

These four circuit sizes each with five impeller sizes and each offering two output performance curves, permit matching the converter to a specific design and minimize compromising the design objective by having to match the engine to the converter.



# Onan 3-KW Diesel Generator Set Features "Vacu-Flo" Air Cooling

ONAN's new 3-kw Model DSL diesel generator set is patterned after the DSP Series formerly made by them. It was developed to meet today's demand for a long-lived, low-priced, rugged, portable generating plant in the 3-kw range.

Because of their compact size and unique cooling system, the air-cooled DSL's are suited for mobile and portable uses. Weighing only 470 lb, it can be taken almost anywhere in its own high-speed trailer or be easily installed in any pick-up truck. A steel turret hood permits all-weather operation and protects it against falling materials on construction jobs.

This power package can also be adapted for marine use. Equipped, with Onan's exclusive cooling system, "Vacu-flo", it is very suitable for operation below decks. The unusual vacuum cooling system provides adequate cooling for the unit plus ventilation of the engine-room and bilge. It uses a powerful centrifugal blower that pulls cooling air through the generator and over heated engine parts, then expels it through a duct to the outside.

Engine and generator are both built by D. W. Onan & Sons, Inc., of Minneapolis, Minn. The 4-cycle, vertical, 1-cyl, diesel has forged steel crankshaft and rods, extra-large bearing surfaces, full-pressure lubrication and a dry-type air filter.

The inherently regulated 4-pole self-excited, single ball bearing-type generator is directly connected to the engine. A control box mounted over the generator contains all necessary controls, meters and switches. In addition to the standard 115, 115/230, and 230 voltages, 60-cycle, the units can be obtained in 24-30-v, 32-40-v and 110-140-v, battery-charging models. Fifty-cycle, 2.5-kw models, are also available.

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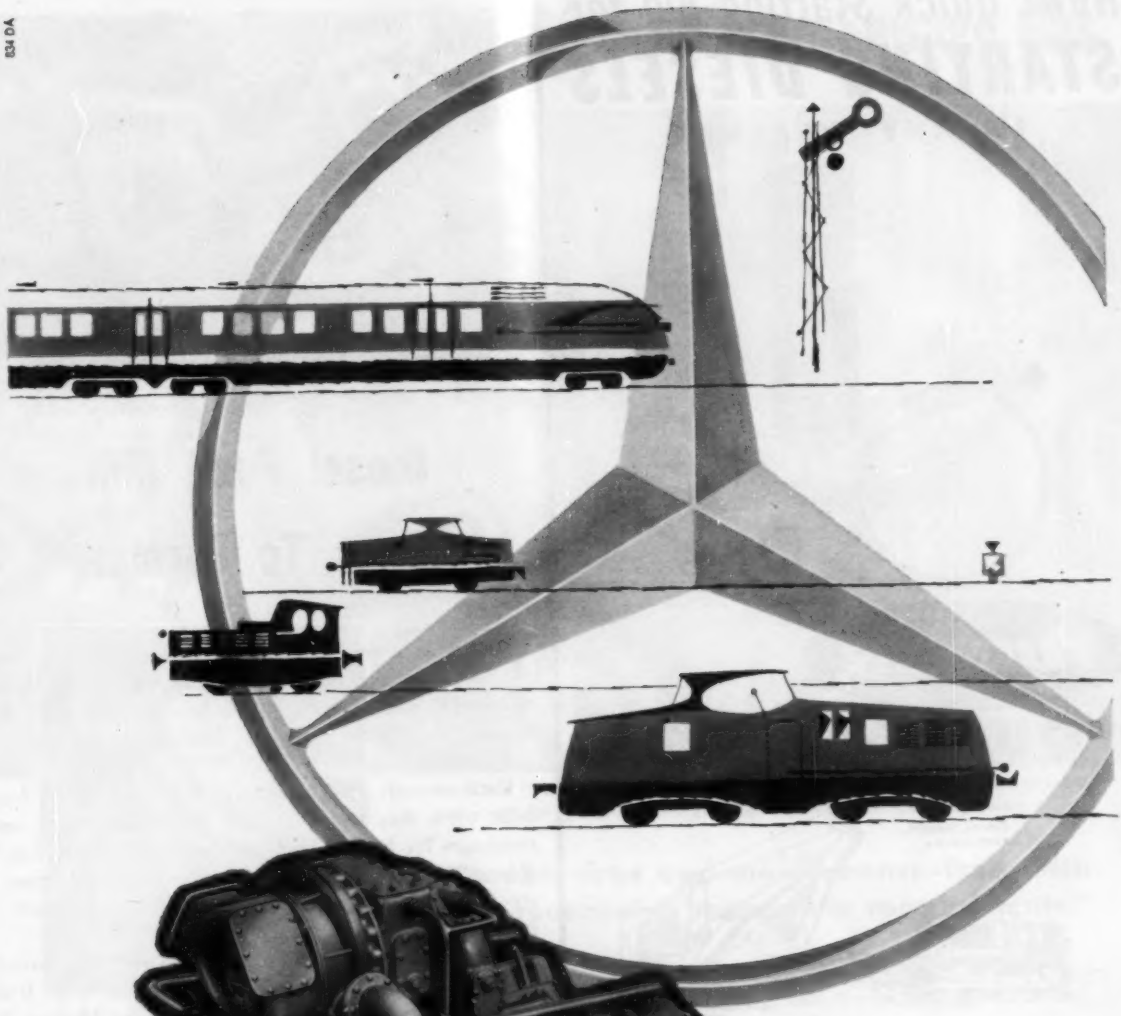

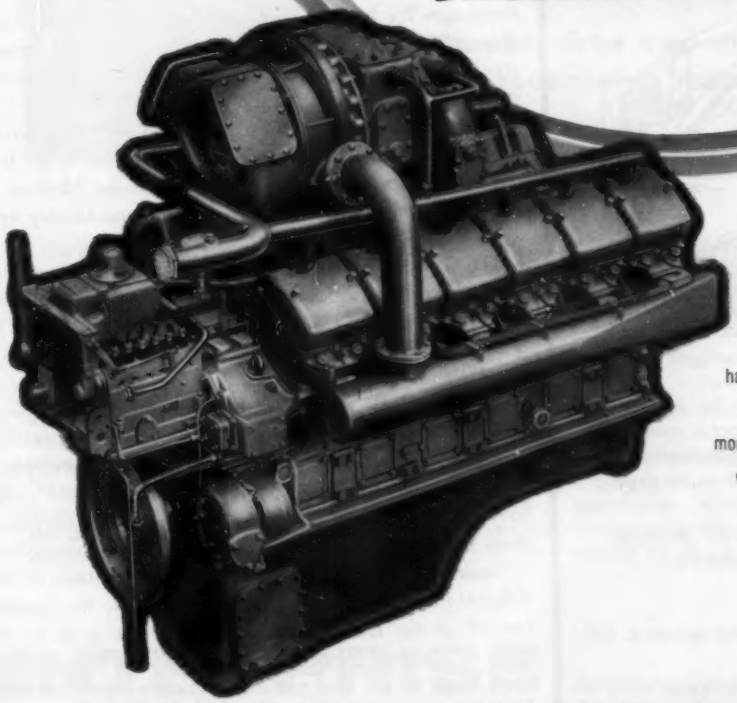

For almost 50 years the Daimler-Benz A.G.
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# New! Quick Starting Aid for STARTING DIESELS

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**QUICK-START**

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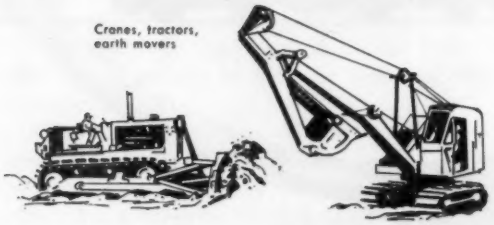

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# Diesel Feed Mill Goes To Farmer

THERE'S a new trend in the farm and feed milling industry. A complete diesel-powered mobile "mill-on-wheels" rolls directly to the farmer, instead of the farmer bringing his grain and roughage to the mill for processing.

Until recently, most farmers went directly to feed mills when they wanted to use their own grains and roughages for feeding livestock and poultry. This is still done on a large scale. However, more and more farmers are using the mobile diesel-powered processing unit—right on their farms.

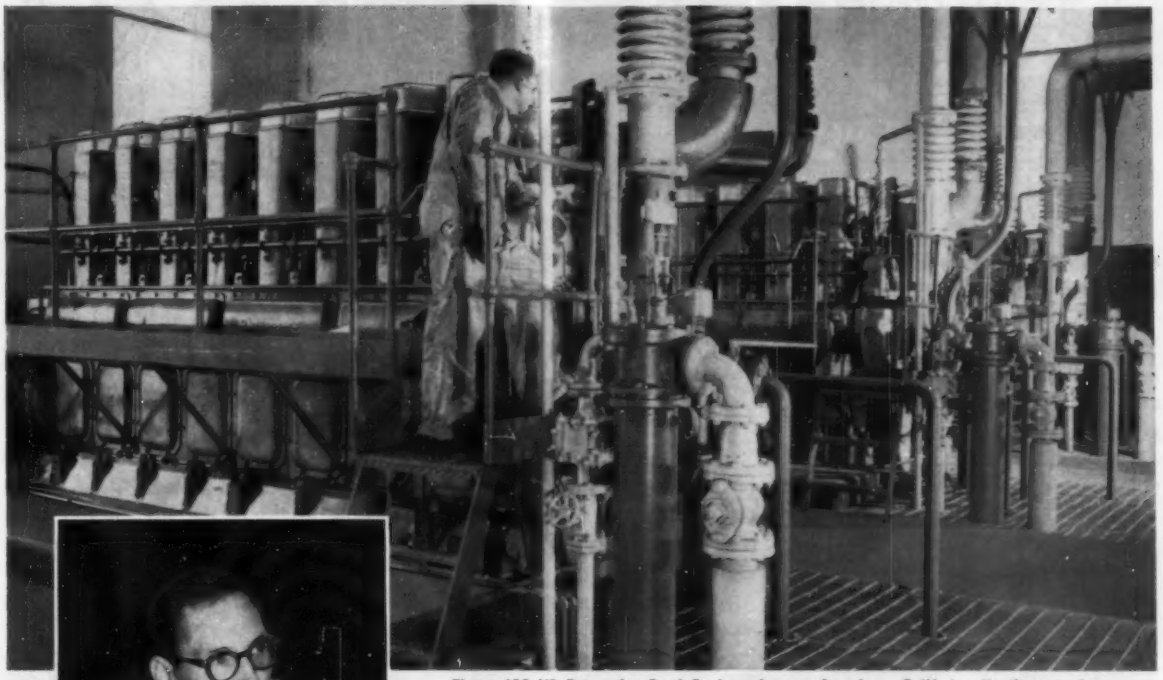
One such mill-on-wheels service, was recentlly started by Meabon & Son Feed Service of Westfield, N. Y. It is owned and operated by Bruce and Raymond Meabon. It is the only one in the Northern Chautauqua County area of New York State.

The 10-ton mill brings a complete feed processing plant right into the customers' farmyards. The unit, made by the Daffin Mfg. Co. of Lancaster, Pa., is powered by a 100-hp GM Detroit Diesel engine. It grinds and mixes up to 10 tons per hour.

As an example of how popular these rolling mills-on-wheels are with farmers, 83 of them have been sold in New York State alone in recent years. Besides independent operators like the Meabons, various feed mills have purchased similar mobile units and are operating them in conjunction with their regular mill operations.

According to Mr. Meabon, one big advantage of the $22,000 machine is that it brings the mill to the farmer, instead of the farmers having to take his grist to the mill. In the past it was necessary to load their grains, truck them to the feed mill, unload them, wait until the feed was prepared. Then they had to load it again, take it back to the farm and unload it into feed bins. By eliminating all this handling, the new mobile farm service saves feeders much time, labor and money.

# Enterprise Engines Run 90% on Free Sewage Gas



Three 625 HP Enterprise Dual Fuel engines at San Jose, Calif. handle the complete power load for all electrical and pumping requirements of this sewage plant.

**"Trouble-free and maintenance-free, with very reasonable manpower requirements."**

Frank M. Belick

Supt., San Jose, Calif., Sewage Treatment Plant

"We're extremely pleased with the record of efficiency and economy experienced to date with our three Enterprise Engines. They have operated trouble-free and maintenance-free, fitting in exceptionally well with our treatment plant requirements.

"By operating on methane, the sludge gas by-product of sewage treatment, our fuel costs have remained at a minimum. In addition, the Enterprise Dual Fuel 'Select-O-Matic'® feature has given us the flexibility we need when sludge gas production becomes erratic. On either gas or oil the engines respond well to changes in power demands. All in all, these engines provide us the dependable, continuous operation we need with very reasonable manpower requirements."

This and other model sewage plants in such cities as New York, East Boston, Mass., and San Diego, Calif., attest to the fact that complete dependability and economy of municipal operations start with Enterprise Engines.

**Engines of Every Type and Size for Every Municipal Need**

Enterprise specializes in engines for stationary and portable electric power generation, flood and water pumping systems, and sewage plant power. Versatile fueling is available in diesel, dual fuel and spark ignited gas engines. Models range from 73 to 7703 HP. Call in the Enterprise sales engineer in your area, or contact factory direct for information or help with your plans.

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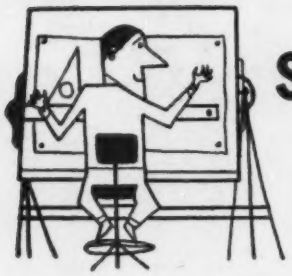


# service section

**Recent engine and equipment modifications, procedures and recommendations straight from the different manufacturers to you**

### Oversize Compression Sealing Rings For Cummins JS Engine

Compression sealing rings, Part No. 70154, used with JS cylinder head gaskets are available in standard and oversize thicknesses as given in the following table.

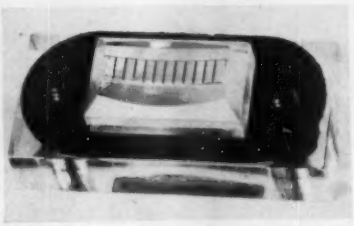
| Compression Sealing | Amount Oversize | Identifying Color On Outside Dia. |
|---|---|---|
| 70154 | Std. | None |
| 103911 | 0.001 | Red |
| 103912 | 0.002 | Green |
| 103913 | 0.003 | Blue |
| 103914 | 0.004 | Orange |
| 103915 | 0.005 | White |

The oversize compression sealing rings should be used to compensate for variations in cylinder liner protrusion between cylinders on a used JS engine.

Cylinder liner protrusion above the block for JS engines is 0.0045 to 0.00675-in. This means a possible maximum variation of slightly more than 0.002-in. protrusion among the cylinder liners. With these rings you should be able to obtain this protrusion more easily and decrease maximum variation to 0.001-in. This will give even longer life to the carrier-plate gasket.

Cylinder liner shims, Part No. 43782, (for insertion between liner flange and block counterbore) must be used to obtain this protrusion at the overhaul period or at any time it is necessary to reface the cylinder block counterbores.

When gaskets are installed, it is very important that sealing surfaces of the cylinder head, liner and block be clean and smooth. Remove all carbon and scale, but be careful not to gouge the surface with the cleaning tool.



### Gauge For Checking Roosa Master Automatic Advance Operation

A transparent plastic "window" fitted in place of the outboard timing-line cover on Model "D" and "E" pumps is now available for checking rate and amount of cam movement.

Each graduation on the gauge represents two pump degrees and cam movement may be checked while the pump is operating. Good visibility of the graduations on the gauge may be obtained by rubbing India Ink on the surface of the plastic and then wiping with a cloth. The ink will remain in the grooves and is not affected by fuel oil in pump.

The gauge, complete with gasket and screws, is available as #1726-1A.

### Washing GM Cylinder Blocks

Whenever rebuilding or overhauling Detroit Diesel engine, it is important that all engine parts be thoroughly cleaned. Therefore, it is suggested all core hole plugs be removed from a cylinder block before it is washed in a caustic or other type cleaning solution.

Removal of the plugs allows the cleaning fluid to contact the inside of all water passages and oil passages in the block thus resulting in more efficient cleaning. Also, if the core hole plugs and gaskets were left in place in the block during washing, the gaskets might be attacked by the cleaning solution. This could possibly lead to internal leaks and eventually engine damage.

When the plugs are reinstalled, it is suggested those originally equipped with aluminum gaskets be supplied with new aluminum gaskets to assure proper sealing at these vital points. The plugs should then be installed, and securely tightened.

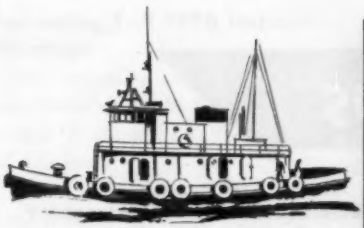
### Torquing Cat Starting Engine Cylinder Head Bolts

Have you ever tightened the stud nuts or bolts on a Caterpillar gasoline starting engine cylinder head? How tight did you get them—about 25-lb ft, 50-lb ft or 100-lb ft?

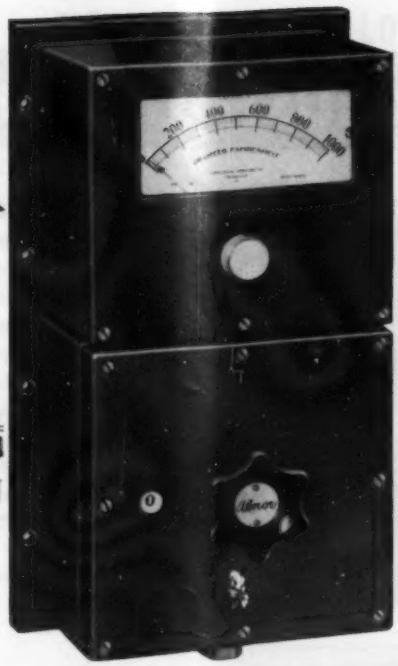
Actually, the degree to which they were tightened probably depended on the length of the wrench you used. It's only logical that more leverage, hence, more torque can be applied with a wrench 15-in. long than can be applied with a wrench 6-in. long. And, it takes more experience than most men get in a lifetime to accurately determine a prescribed amount of torque to which a bolt or nuts should be tightened.

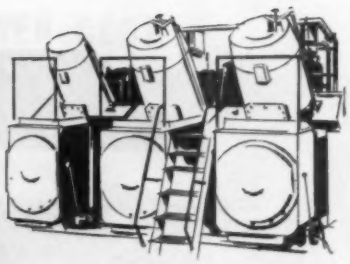
Many starting engine cylinder head and head gasket failures are the direct result of undertightened or overstressed cylinder head bolts or nuts. Therefore, use a torque wrench when tightening the bolts or nuts to the following recommended torque values.

| *Starting Engine Model* | *Torque* |
|---|---|
| 10-hp Horizontal (2¾-in. Bore) | 35-lb ft |
| 15-hp Horizontal (3⅛-in. Bore) | 55-lb ft |
| 24- and 25-hp Vertical (3⅝-in. Bore) | 55-lb ft |

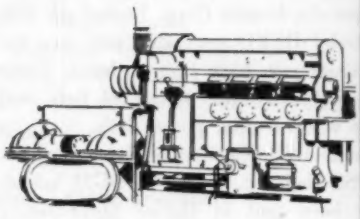


Marine

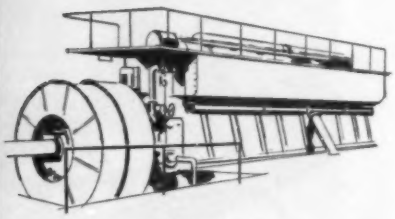




Engine compressor



Pumping



Stationary

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|---|---|---|
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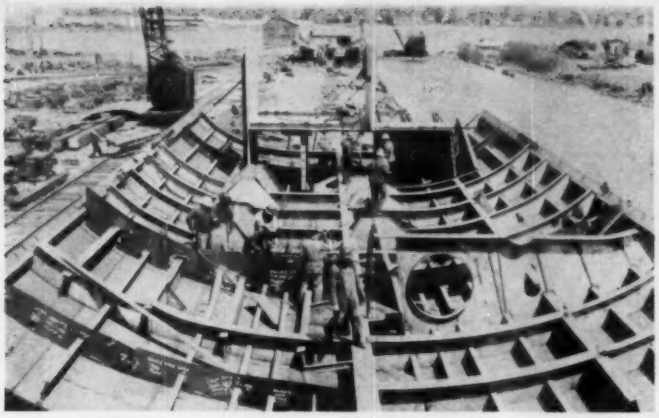
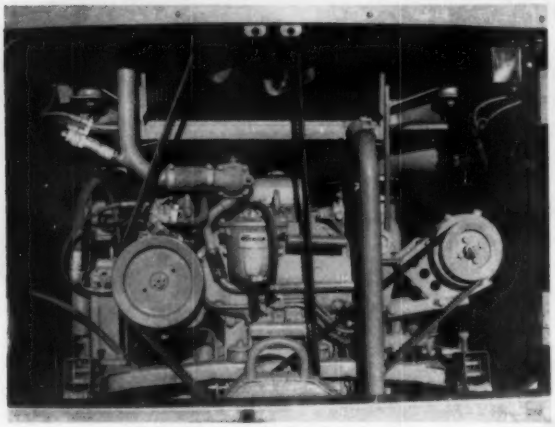
# industry news



### Hercules Diesels Provide Emergency Power For Missile Ships

Emergency power for our Navy's future fleet of 13 missile-launching destroyers will be supplied by diesel generator sets made by Hercules Motors Corp. Twenty-six 100-kw model DFXD generator sets, two for each destroyer, have been ordered. These will provide the sole source of light and power when regular power fails.

The keel for the first of the new ships, the USS Henry B. Wilson (DDG7) has already been laid at DeFoe Shipbuilding Co., Bay City, Mich.

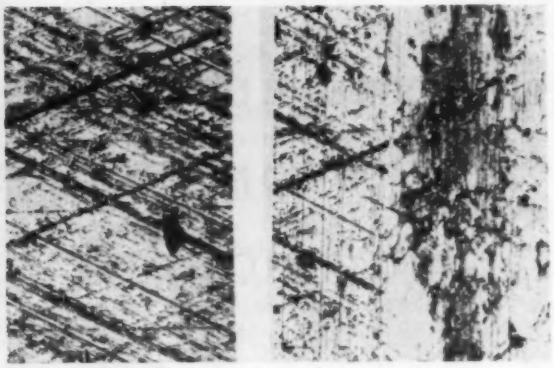


### Over 300,000 Miles Without Overhaul

A diesel in one of the Saskatchewan Transportation buses completed 306,193 miles without any major overhaul. The unit, a GM 4-cyl, 2-cycle diesel is rated 153 hp at 2200 rpm. It is one of several such units installed in this Company's buses which have completed 275,000 miles or more without any major repair.

Purchased in 1954 with 15 others, the engine is being stripped down for routine overhaul. Speaking from experience, Mr. R. D. Mahara, operations manager, says that in all probability the engine will only need rings, pistons and sleeves. Measurements and magnifluxing has shown the crankshaft to be straight and without cracks. Journals and throws show no appreciable wear or taper. When overhauled, the engine should be good for another 300,000 miles or more.

During all its miles of travelling, plus many hours of idling in bus depots, the engine was in the same bus. It exceeded a previous record set by an identical GM diesel by more than 25,000 miles.



### What Causes Liner Scuffing?

The search for a better understanding of what causes cylinder scuffing has led to use of plastic replicas for following wear progress. An engine is run under increasingly severe conditions until scuffing occurs. Plastic replicas of the liner wall are made at intervals by removing cylinder heads and lowering the pistons. The replicas are then examined under a light microscope.

Photo of plastic replica at left shows liner wall before scuffing. Rough vertical bands in photo at right, (taken later) shows scuffing. Diagonal honing pattern, seen in both photos, made it possible to locate same area in replicas made at various stages of engine run.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### Remaining SAE 1958 National Meetings

The following national meetings are scheduled by the Society of Automotive Engineers for the remainder of this year.

The SAE National Transportation Meeting will take place on October 20-22 at the Lord Baltimore Hotel in Baltimore, Md.

The SAE National Diesel Engine Meeting is scheduled for October 22-24 at the same hotel.

The SAE National Fuels and Lubricants Meeting will occur on November 5-6 at the Mayo hotel in Tulsa, Okla.

### Diesel Plant Engineers & Operators Short Course

Personnel connected with diesel engine operation and maintenance will profit by attending a 4-day program conducted by engineers from the industry.

A diesel plant engineers & operators short course is planned for Sept. 22-25 at the Allerton House, Allerton Park, Monticello, Ill. The subjects to be discussed are: combustion; indicators; governors; injection; bearings; pistons; fuels and lubrication; dual-fuel engines; preventive maintenance; plant safety; diesel theory; and gas turbine trends.

Registration fee is $12.50 payable to the University of Illinois.

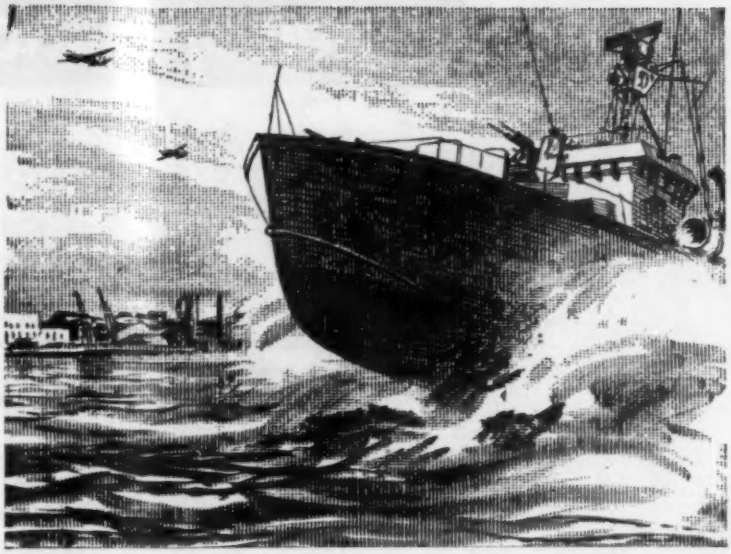
### Worthington Engine-Compressor Installed

A Worthington SLHC 4-cyl turbocharged engine-compressor has been installed at the Permain Basin Pipeline Company's compressor station near Jal, New Mexico. It is used for gathering low pressure natural gas in the Permian Basin. The 450-rpm Worthington unit is rated 317-bhp at 3700 ft.

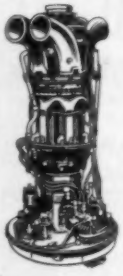
This skid-mounted unit is one of two units fabricated by the Foor Engineering Co. The engine was equipped with skids, engine and gas cooling equipment, gas scrubbers and safety controls by Foor Engineering before being sold to the Permain Basin Pipeline Co.

(*Continued on Page* 56)

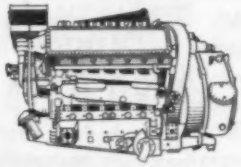

**MORE POWER AT LOWER COST**



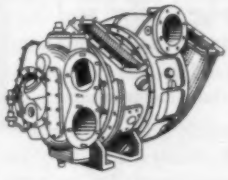
***THIS IS NAPIER***



GAZELLE 1260/2000 s.h. p. Free Turbine:
designed for strenuous duty and long service between overhauls. Chosen for R.N. and R.A.F. helicopters. Allows new flexibility in helicopter design. Its simplicity means economical and speedy maintenance.



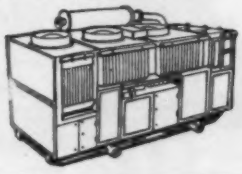
DELTIC 9 or 18 cylinder Diesel:
engine for merchant ships. Powers fast patrol boats and mine-sweepers of many Navies, police and passenger launches and the world's most powerful diesel electric locomotive. Deltic Diesel Engines are designed for power outputs from 825 to 3,100 h.p.



TURBO BLOWERS:
available in seven sizes for diesel engines afloat and ashore. Napier blowers give maximum power increase with low fuel consumption. Now in service in 84 countries.

ELAND 3000/4000 e.h.p. Turbo Prop:
heralds a new era of economy for the airline operator and cheaper fares for the air traveller.
The Eland powers the Canadair 540 Airliner, the Fairey Rotodyne and the Westland Westminster Helicopter.

DELTIC COMPAK
A compact source of power easily transportable to normally inaccessible places, comprising Deltic Diesel engine plus generator, radiators, fuel tanks pumps, etc. Road, rail and skid mounted sets at 1,200 kW and rail mounted sets at 2,640 kW. Weight 35,000 pounds. Envelope 24x8x11 ft



***NAPIER ENGINES INC.***

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# new products

### Unitest Universal Testing Equipment

The lapping lathe and universal grinder made by the Spiralap & Unitest Div. of Marine Pumps, Inc., Wilmington, Calif., are precision engineered for accuracy in fuel injection service. These and other units in the line of Unitest Universal Testing Equipment will be displayed at the Association of Diesel Specialists meeting at the Sherman Hotel in Chicago, on Sept. 18-21.

The lapping lathe (left), for lapping nozzle seats, can be controlled within a wide speed range of 250 to 4200 rpm. Proper speed can be set for use with cast iron, stainless steel or stone-type lapping arbors. A unit-mounted tachometer shows speed.

The universal grinder (right), is used to condition arbors and grind nozzle needles. Fixtures permit grinding laps or needle stems up to 5/8-in. diameter and 9-in. long.

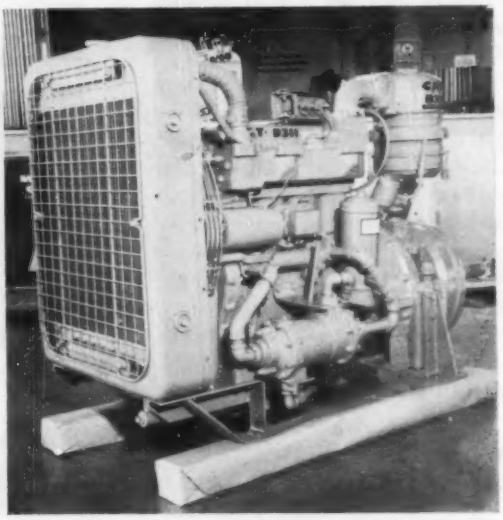
### Caterpillar Adds Another Diesel

Caterpillar Tractor Co., Engine Division's latest diesel is another step in their program to build more powerful models that are smaller than the engines they replace. In replacing the Cat D311, the new D311 Series H output was boosted 10 hp, or over 15%. It is 9-in. shorter, 17-in. lower and weighs 350 lb less.

The new 4-cyl, 4-in. bore by 5-in. stroke, 4-cycle, unit uses the same precombustion chamber design used on all Cat diesels. This 252-cu in. displacement engine develops 75 hp at 2400 rpm. It has an intermittent rating of 68 hp and a continuous rating of 50 hp at 2000 rpm. A turbocharger which will soon be available will considerably increase these ratings.

The fuel system is of same general design as that used since 1931. It uses capsule-type fuel injection valves and pumps free from all field adjustments.

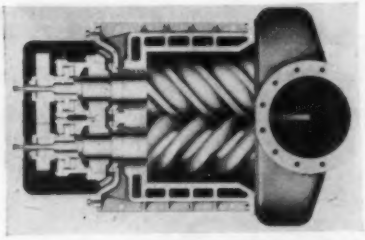
The engines are available as industrial, electric and marine units.



### Mack Unveils New Bus

According to reports from Mack trucks Inc., they have combined a dependable, economically-operating, compact diesel power plant with the latest advances in bus design, in producing a new intercity bus.

The 41-passenger unit is powered by Mack's turbocharged Thermodyne diesel. It features a 4-speed transmission especially developed for it, power steering, all-welded tubular framing, airglide suspension system and air conditioning. All major components such as the engine, transmission, axles and body are made by Mack.



### F-M Announces Rotary Compressor Line

Fairbanks-Morse reports that their new positive-displacement rotary compressor rivals that efficiency and stability of reciprocating machines while matching the compactness and low maintenance of centrifugals. It is designed for continuous heavy-duty industrial service handling air, gas or vapor. Rated 800 to 13,000 cfm, it is expected to have wide applications. It can be used by heavy industry including engine builders, mining, steel mills etc. It can also be used for gas transmission and distribution.

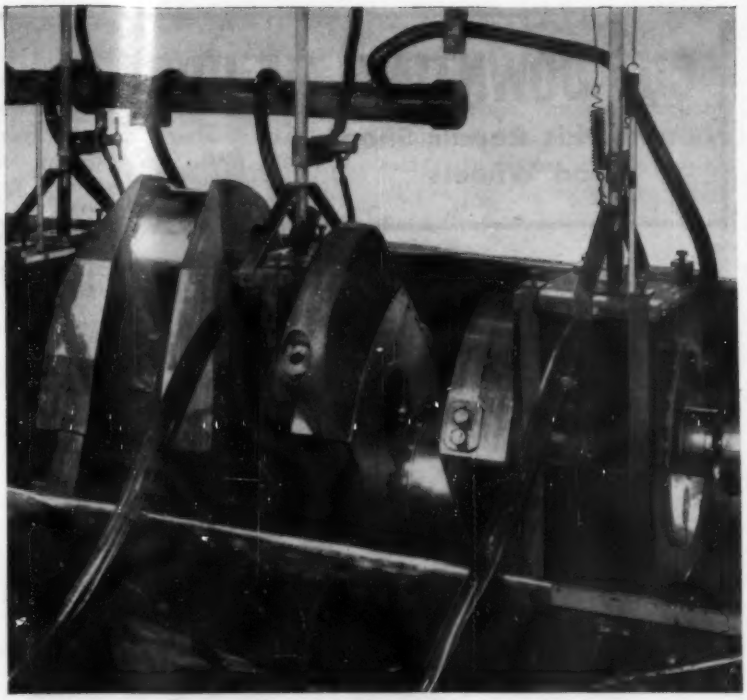
The compressor is a 2-impeller, helical-lobe type, axial-flow, rotary machine with 4-lobe power impeller and a secondary impeller with six matching gaps synchronized by timing gears. Because of it's high operating speed, it can be driven efficiently by a diesel or gas engine and gas turbine or motor.

### Chassis Dynamometer Has New Features

A machine for complete road testing of trucks, buses and autos right in the shop has been announced by the newly-formed Otis Auto Dynatester Corp. Called a dynatester, the unit is basically a dynamometer. It differs from other chassis dynamometers in that it can both absorb and apply force while operating at road speeds.

The dynamometer provides means for accurate engine tune up. Effects of fuel injection timing, combustion efficiency, etc., are shown and optimum adjustments can be made.

The unit can also be used to check: driving force exerted by tires; braking force; vehicle acceleration and deceleration; speedometer calibration; and steering and chassis alignment.

THIS REBUILT CRANKSHAFT IS CHROMIUM PLATED BY A SPECIAL NATIONAL FORGE PROCESS

When your crankshaft is reconditioned at National Forge, here's how it is chrome plated. Each bearing surface is individually boxed and plate thickness is built up only as required. Different thicknesses—over ⅛" if needed—can be added to different surfaces of the same crank. Because only the boxed surfaces are exposed to plating action the fillet areas retain their original strength.

When applied by National Forge specialists, chrome plating is uniform and smooth. Regrinding is kept to a minimum and your reconditioned crankshafts are returned to you meeting the original shaft's specifications.

No other plating company has National Forge's experience in handling both new and rebuilt crankshafts. So why not try National Forge specialists on your crankshaft rebuilding jobs?

This is a finished, repaired crankshaft after processing by National Forge.

*For more details on crankshaft repair, write for Bulletin RC-3.*

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# CUT DOWNTIME TIE-UPS

**with this Repair Shop on Wheels**

New Snap-on 5232 GS-BB set

This big, new *Snap-on*® set puts 232 of the most used wrenches, sockets, screwdrivers and other tools right at a mechanic's finger tips — gives him a real tool layout that gets idle equipment back into action fast.

**IT'S PORTABLE!** Roll the complete unit around the shop — load any section or all of it on a pickup truck for transport to the job site.

**IT'S FLEXIBLE!** Get any part of the set or make substitutions either in tools or the drawer combinations to fit your own needs.

**IT'S IMMEDIATELY AVAILABLE** — wherever you are! With 58 branch offices throughout the U.S. and Canada, you can get this set or any other *Snap-on* tools on short notice.

**IT'S EASY FOR MECHANICS TO OWN!** If you want your mechanics equipped with this set, show them this ad Convenient credit terms make it easy to own.

Don't let lack of the right tools jam up your repair schedules. This 5232 GS-BB set gives you a range of tools and tool sizes to service both light and heavy equipment. And, top-quality *Snap-on* tools have the feel, fit and long life that run-of-the-mill tools can't begin to match.

*Get full details about this set from your Snap-on man.*

SNAP-ON TOOLS
CORPORATION
8064-I 28th Avenue • Kenosha, Wisconsin


## new products

### V-Band Tube Joint

A leak-proof, self-aligning tubing connection has been developed by the Marman Div. of the Aeroquip Corp. Called the "Servicemaster V-Band Tube Joint", it is especially designed for truck, bus and construction diesel exhaust systems and for stationary engine ducting.

Only two bolts are needed to make the joint tight. As these bolts are tightened, the Service master's vee-shaped internal surface exerts an inward radial force. This wedges the two flanged tubing ends together with an even contact around the entire circumference. No special gaskets, tools or skills are needed to make the connection.

### Low Cost Portable Crack Detector

The United States Casting Repair Corp., has announced development of a low cost, completely portable crack detector. This 20-lb unit is easily operated by one man. It can be operated from either a 110-v a-c line, 12-v or 6-v battery. This makes crack inspection possible in areas where electrical lines are not available.

Based upon the principle of magnetic particle inspection, the Seal-Lock magnetic crack detector is said to locate and outline any surface crack or fault on any ferrous casting. It will spot fine hairline cracks that are invisible to the eye.

### Wet Pressure Blaster

Simple and efficient operation, wide visibility and easy installation are features of the new Clemco wet hone, wet pressure blaster machine made by Clementine, Ltd., San Francisco. Slurry agitation is said to be immediate, regardless of non-operational time or type of abrasives used. A foot lever controls cleaning, deburring, honing or polishing.

### Air Cleaner Warning System

A dry-type air cleaner gets more efficient when it becomes dirty. However, in taking more dirt out of the air, it increases resistance to air flow and the engine starves for air. The condition is not apparent until engine performance suffers.

A warning system developed by the McQuay-Norris Mfg. Co. tells you when the dry-type filter is getting clogged—thus giving you a chance to prevent starving the engine of air.

This warning system consists of a sensitive vacuum switch that actuates a light when the cleaner becomes clogged and excessive vacuum builds up in the intake manifold.

The switch, housed in a lightweight aluminum housing, is not affected by corrosion, dirt, water, oil, vibration, and temperatures up to 250°F. It can be adjusted within 5 to 30-in of water, either at the factory or in the field.

### Spark Arrestor Approximates Muffler Size and Shape

A compact spark arrestor that approximates the size and shape of a muffler is now available for diesel-powered forklifts, pickups, loaders, and the smaller tractors, trucks, harvesters and stationary units.

This new Gill spark arrestor uses a straight-through exhaust-flow-principle and a new cyclonic action that is said to be almost 100% efficient in trapping dangerous incandescent exhaust carbon. It can be placed at the end of, or within the exhaust system and mounted at any angle. It is made in sizes to accommodate diesels up to 325-cu in. displacement.

Exhaust carbon is retained within the arrestor and dumped periodically through an easily accessible port.

### Hydraulic Impact Wrench

A hydraulically-operated impact wrench has been developed by the Owatonna Tool Co. It features 1-in. square drive and exerts up to 900-1000 ft lb of torque.

The tool is designed to operate from the hydraulic take-off on the company's Trackmaster hydraulic track press, thus eliminating the need for an air compressor or an electric power source. However, any hydraulic power source, with a flow of up to 6.5 gpm at 1000 psi can be used.

### Spray Engine Cleaner

You can now spray-clean dirty engines from a can. "Kleen-Off Spray Motor Cleaner," made by DeMert & Dougherty, Inc. is said to quickly spray-clean engines of grime, grease, oil and dirt. To use it, you simply spray the dirty surface and hose off with water.

"Kleen-Off" is packaged in a 16-oz. aerosol container. Spray is released through the top of the spray-head by pressing a finger to side of valve.

with a **TOBIN-ARP** *Precision Engineered*
**LINE BORING MACHINE**

Precision centering with dial indicator to *positively* restore original center line of main and cam shaft bearing bores in warped or worn engines. Both models offer heavy duty capacity to bore Bearing Saddles in crank case castings for precision or plated bearings. Equipped with motor drive and hydraulic feed, a TAMCO Line Boring Machine will accomplish the largest or the smallest job (within range) with equal ease and accuracy.

**MODEL TA-15** (shown above)
**CAPACITY:** Will handle engines with 96" overall spread of main or cam bearings. 20" side of crankcase to main bearing center line. 42" from table to bearing line. Wt. 1500 lbs. Shipping Wt. Domestic 1900.

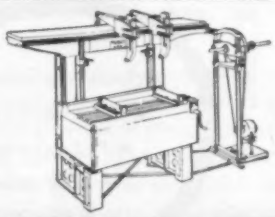
**DIMENSIONS:** Height 65", width 36", length 118". Add 3 ft. to length for minimum operating space.

**TOBIN-ARP MFG. CO.**
6400 PENN AVENUE SOUTH
MINNEAPOLIS 23, MINNESOTA

A TAMCO PRODUCT

**MODEL TA-14**
**CAPACITY:** Will handle engines with 72" overall spread of main or cam bearings. 16" side of crankcase to main bearing center line. 32" from table to bearing line. Weight 1200 lbs. Shipping weight Domestic 1500.

**DIMENSIONS:** Height 55", width 32", length 93". Add 3 ft. to length for minimum operating space.



# people and plants

George Steven

### Promotion at Worthington

George Steven has been named general manager of the Compressor & Engine Div. of Worthington Corp. at Buffalo, N. Y. He replaces A. C. Ross, vice-president, who retired after serving Worthington for 26 years in key purchasing, manufacturing and managerial positions.

Mr. Steven joined Worthington at the Cincinnati Works in 1923. In 1932 he was transferred to the Buffalo Div. where he served as assistant chief, and chief engineer-compressors, manager of engineering and assistant general manager.

### R. A. Schakel Dies

Raymond A. Schakel, Sales Manager, Diamond Chain Company, died in Indianapolis, Ind., his home, at the age of 58. Mr. Schakel was well known and liked in the diesel and automotive industries. As a business associate and as a person, he will be missed.

In addition to his many contributions to the improvement of these industries as part of his work, he contributed generously by participation in Technical Society activities —notably the American Society of Mechanical Engineers. He was a member of the Executive Committee of the ASME Oil and Gas Power Division, Chairman of the Technical Program Committee, and slated for early Chairmanship of the Division.

Robert Hawkins

### Appointed to Zollner Board

Robert B. Hawkins has been elected vice president in charge of sales and a member of the board of directors of Zollner Corp., Ft. Wayne, Ind.

Mr. Hawkins previously served as Zollner general sales manager out of the firm's sales office in Birmingham, Mich. He has been affiliated with the automotive industry many years. He has specialized in the developments and sale of pistons and other automotive products.

### Chromium Plating Plant Opens

Chromium Corp. of America has opened a new industrial chromium plating plant at 8701 Union Avenue, Cleveland, Ohio.


KIM
Hotstart
electric pre-heater
for Diesel Engines

KIM HOTSTART pre-heaters circulate hot water through engines when they are not in use; protect them against bitter winter weather; keeps engines responsive to the touch of the starter. Lightweight; low cost; high in savings. Thousands in use.

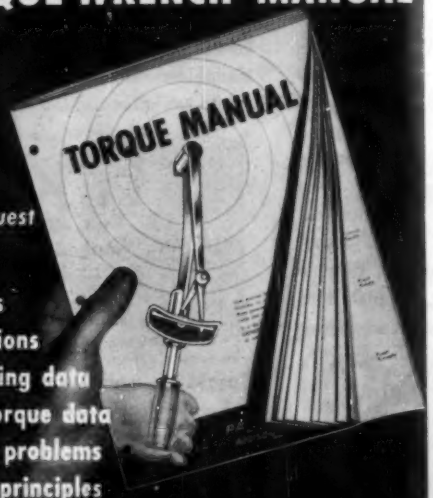
★ *Quick easy starts*
★ *Saves warm-up time*
★ *Reduces engine wear*
★ *Cuts maintenance costs*
★ *Easy to install*

Write for literature.

KIM HOTSTART MANUFACTURING COMPANY
West 917 Broadway, Spokane 1, Washington

GRIND CRANKSHAFTS IN THE BLOCK!
The Winona Lathelok Crankshaft Grinder has given fast, accurate service in the Automotive field for over 18 years. Now it's available to the Diesel field. With a new large hook, the standard grinder will now grind shafts up to 3½" in diameter in the block!
WRITE FOR DESCRIPTIVE LITERATURE AND PRICES.
WINONA TOOL MFG. CO.
WINONA, MINN. U.S.A.

"TORQUE WRENCH" MANUAL

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ADDISON QUALITY ILLINOIS

Manufacturers of over 85% of the torque wrenches used in industry

KIENE®

UNIVERSAL INJECTOR TEST STAND—

For Testing all Unit Injectors in One Fixture. Makes Plunger and Bushing Tests on all General Motors Unit Injectors.

KIENE HYDRAULIC TEST PUMP — For making all conventional Tests on Nozzles. Photo shows use with Universal Injector Test Stand.

KIENE CONNECTOR NUTS — For convenient Attachment of Equipment to Test Stand or Test Pump. All sizes Connectors available.

KIENE PORTABLE TEST EQUIPMENT

An entirely new and different product for the Diesel Industry offering features never before available in the field of Injection and Hydraulic repair and Servicing tools. Kiene Injector Test Stand and Hydraulic Pump give you all operating advantages of existing tools in addition to introducing many new and exclusive features. Kiene Products are Portable, Light Weight Compact, Rugged and Revolutionary in Design. They are engineered to give the Field Service Man adequate tools for on the job diagnosis and quick repair of valuable Diesel Equipment.

SAVE MONEY — SAVE DOWN TIME

Write for Bulletins KTP-50 and UTS-10

KIENE DIESEL ACCESSORIES, INC.
10352 PACIFIC AVE., FRANKLIN PARK, ILLINOIS

### AAF's N. Y. Offices Change Address

American Air Filter Company's New York City Branch Office has changed its address. It is now located at 292 Madison Ave. No change was made in the telephone number, it is still ORegon 9-0424.

The firm's Eastern Regional Office has moved into 292 Madison Ave., N.Y.C. It's telephone number is ORegon 9-6844.

### Oakite Appoints Industrial Sales Manager

William A. Baltzell, formerly assistant sales manager, has been appointed industrial sales manager for Oakite Products, Inc. He will be responsible for the work of the company's 17 divisions and 240 technical service representatives throughout the U. S. and Canada.

Mr. Baltzell joined Oakite's field service staff in 1941, became southern division manager in 1946, and assistant sales manager in 1953. He is a member of the company's board of directors.

E. W. Kettering

D. M. Lyon

### Promotions at E M D

David M. Lyon has been appointed director of research of the Electro-Motive Div. of GM. He succeeds E. W. Kettering who is now research assistant to the general manager.

Mr. Kettering has contributed to the development of GM diesel locomotives since 1930 when he joined the Winton Engine Co. which later became the Cleveland Diesel Engine Div. of GM. He joined EMD, in 1938, and became director of research in 1955 after holding many important positions.

Mr. Lyon joined EMD's mechanical engineering section in 1948. He was attached to engineering sales in 1954 and 1955, and became member of the research staff 1955.

### New C-B Branch Manager For Mexico City Office

Guillermo Freytag is the new branch manager of the Mexico City office of the Cooper-Bessemer International Corp. He will direct the application and sale of C-B engines and compressors in Mexico.

### Freightliner Corp. Personnel Changes

Bill LeFevre, chief engineer at Freightliner Corp. is now head of the newly organized Engineering Research and Development section. As a member of the general managers' staff, he will recommend engineering policy and goals.

As a result of establishing two engineering sections to permit greater diversification in designing and building heavy-duty trucks and tractors, Norm Chew was appointed chief engineer in charge of production. His department will handle all processing of truck orders and assume full responsibility for designing new parts and issuing parts books to the field.

## people and plants

### Nordberg Opens New Warehouse

Warehouse facilities for diesel and gas engine parts have been established in Vancouver, B. C. by the Engine Div. of Nordberg Mfg. Co.

According to R. W. Bayerlein, vice president, this was required because of the increasing number of Nordberg engines in service in western Canada.

### Exide Expands Industrial Battery Service

Exide Industrial Div. of The Electric Storage Battery Co., Philadelphia, has expanded its system of regional service stations and warehouses.

A new post of supervisor of service stations and warehouses has been created in the division's service engineering department. C. L. Eberhardt, Jr., former manager of Exide's Boston depot, has been appointed to post.

Former manufacturing depots in Boston and Detroit have been converted for use as industrial battery service stations. Plans call for additional service station facilities in other key-cities.

F. R. Gruner

H. M. Gammon

### Purolator Appointments

Frederick R. Gruner, chief engineer, has been appointed director of engineering of Purolator Products, Inc. He will be responsible for all engineering activities of the company.

Howard M. Gammon, executive assistant to the president, is now chief engineer in charge of all engineering activities at the company's central plant in Rahway, N. J.

Mr. Gruner joined Purolator in 1956 as chief engineer. He is a registered professional engineer, and a member of the American Society of Mechanical Engineers; Society of Automotive Engineers; American Institute of Mechanical Engineers, the National Society of Professional Engineers, and the MIT Club.

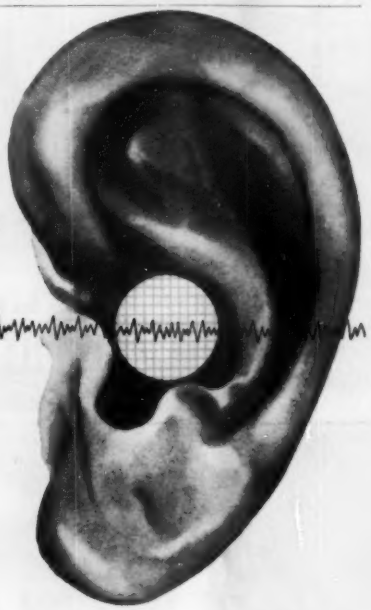
Mr. Gammon, joined Purolator in 1958 as executive assistant to the president. He is holder of several patents in automotive equipment.

### New Heat Exchanger Service

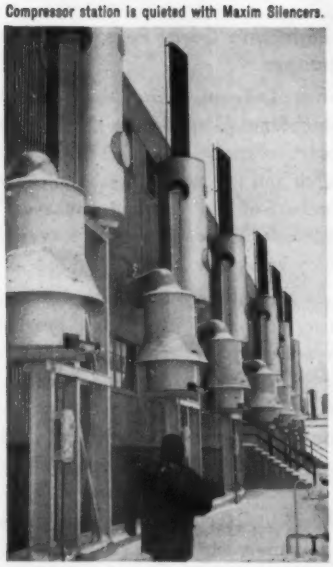
The Harrison Radiator Div. of GM Corp. has appointed Berdell Industries Inc., as authorized service repair center for the servicing of Harrison heat exchangers. They are located at 44-30 Purvis St., Long Island City 1, N. Y.

This organization is equipped and qualified to handle all servicing of Harrison heat exchangers. A large stock of material necessary for the servicing of these units is carried on hand at all times. All work is done to strict factory specifications by factory-trained personnel and carries a Berdell guarantee.


HEAR THE DIFFERENCE A MAXIM MAKES



Compressor station is quieted with Maxim Silencers.



The difference is apparent not only in superior noise suppression, but in the services Maxim provides. *Quick* consultation on your silencer projects — there's a Maxim man near you. *Quick* delivery — many sizes and types from stock. *Experienced* field engineers to help you complete silencer installations quickly, economically and efficiently. Files up-to-date? Make sure. Write for "Guide to Maxim Silencers."

THE MAXIM SILENCER COMPANY

Subsidiary of Emhart Manufacturing Company

93 HOMESTEAD AVENUE, HARTFORD, CONNECTICUT

### Mack Trucks Improves Main Assembly Center

Mack Trucks, Inc., has completed installation of a modern new electronically-operated cab assembly line at its main assembly center in Allentown, Pa. They have also placed a new axle shaft manufacturing department in operation there for the first time.

The two new production units, costing approximately $1½ million, are part of a long-range plant modernization program underway by Mack. Mack's axle shafts formerly were manufactured at the Company's New Brunswick, N. J. plant.

### Cooper-Bessemer Acquires Texas Subsidiary

Creole Engineering, Inc., Houston, Texas, is now a Cooper-Bessemer wholly-owned manufacturing and engineering subsidiary. The entire Houston operation is to be headed by T. E. Kraner as president. He was formerly district mgr. of C-B's Caracas, Venezuela office, and more recently of the New Orleans office.

Initial engineering and construction at the new subsidiary will concentrate on the completely packaged, pre-piped gas engine compressors such as the model GMXD. These gas-gathering units currently being marketed by C-B throughout the world, were formerly packaged by other companies.

### Donaldson Plans Fourth Plant

Donaldson Co., Inc. St. Paul manufacturer of industrial air cleaners and mufflers has announced plans to open a fourth manufacturing plant. Frank Donaldson, president, said its operation will be devoted principally to production of elements of a dry air cleaner called Donaclone, recently developed by the firm's research division.

The new plant will be located in Chillicothe, Mo. Ground-breaking for the one-story, 46,500-sq. ft. building is expected to take place early this fall. Actual operations started in Chillicothe in temporary quarters early in August.

### A-C Appoints NYC General Sales Mgr.

M. J. Rotroff has been appointed general sales manager in New York City, for the Tractor Group of the Allis-Chalmers Mfg. In his new capacity he will represent A-C in the sale of Tractor Group products to national and international users who purchase such products in N. Y. C. All such sales will be in cooperation with and for the account of the appropriate Allis-Chalmers dealer.

### Yates-American Names Division National Sales Manager

Yates-American Machine Co. has appointed Donald W. Smith as national sales manager of the Heat Transfer Products Div. Mr. Smith, has a background of many years' experience in OEM sales.

His appointment is keyed to an expansion program in the Yates-American Heat Transfer Div. A broad dealer organization is being developed with addition of representatives in major U. S. marketing areas.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Heavy-Duty

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Designed to meet the needs of Oil Field and other rugged service—this ROCKFORD Extra Heavy-Duty POWER TAKE-OFF

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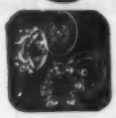
CLUTCHES


Small Spring Loaded

Heavy Duty Spring Loaded

Oil or Dry Multiple Disc

Heavy Duty Over Center

Power Take-Offs

Speed Reducers

# new literature

### International Congress of Combustion Engines

A volume containing the proceedings of the International Congress of Combustion Engines Conference at Zurich, Switzerland, in 1957 is now available. The volume contains the texts of lectures, technical papers and discussions presented during the Conference. It can be ordered from the Swiss Association of Machinery Manufacturers, for 65 Swiss Francs per copy, postage excluded.

### Engine Heaters

How the "Zero Start" line of engine heaters work, how they're used and how they're installed, are told in a series of bulletins available from the Phillips Mfg. Co.

Included are: external tank-type heaters; coolant immersion heaters; and oil immersion dip-stick heaters. Drawings show hook-ups for each.

### Safety Guidebook

"Your Guide to Safety in Road Construction Work", a 28-page book, is the first of three new road construction booklets to be made available this year by The Association of Casualty and Surety Companies. It contains sections on: General safety; electrical hazards; motorized equipment and machinery; material handling; personal protective equipment; hand tools; first aid; fire hazards; and explosives and blasting.

### Protective Equipment Catalog

Kysor Protectostat assemblies safeguard your engine against damage from high temperatures and/or low oil pressures. A bulletin available from the Kysor Heater Co. tells exactly what equipment is available to protect your engine and how it can be arranged and installed to either give an alarm and/or stop the engine automatically in case of trouble.

### How to Become A Professional Engineer

Professional engineers are always in demand. A book just published, "How to Become a Professional Engineer" can benefit unlicensed engineers-in-practice and young graduates by showing them how to obtain a professional engineer's license.

J. E. Constance the author lists and clarifies the seven basic licensing requirements; summarizes various state registration laws; shows how examining boards evaluate experience; explains how to prepare an application; gives pointers on selecting qualifying experience and writing it up; shows how to prepare for examinations and avoid emotional stress during tests; points out what to look for—including pit-falls—in refresher courses; and tells how to achieve multiple-state registration.

Price of the book is $5.50.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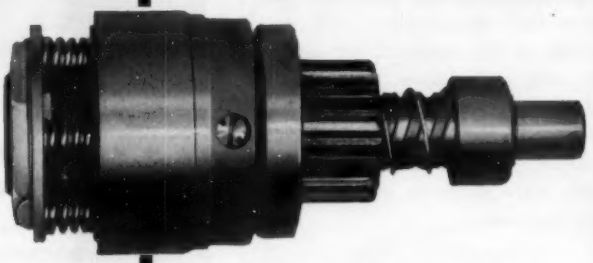

In starter drives BENDIX means QUALITY. That fact, accepted by automotive men for almost half a century, is just as well-known to diesel engineers today. That's why the Bendix* Starter Drive is standard equipment on more diesel engines than any other make. It can be mounted more easily and in more positions. It requires no actuating linkage—the solenoid can be placed in any convenient position. It is simple in design, has fewer parts, needs fewer adjustments. No matter what your type of diesel, you'll be wise to specify and demand the Bendix Starter Drive for outstanding performance and economy. *REG. U.S. PAT. OFF.

Bendix-Elmira, N.Y.
ECLIPSE MACHINE DIVISION

Bendix
AVIATION CORPORATION

### Service Tips on Filter Replacement

Are you using the correct procedure when changing filter elements? Some helpful service tips on filter replacement are given in "Not An Element Of Doubt", a booklet by Caterpillar Tractor Co. Also, filtering improvements developed by Cat are explained in detail.

The booklet contains cost study data plus recommendations for extending oil change periods. Cutaway photos show inner parts of filter elements and point out design characteristics. Importance of proper fit, temperature stability and oil flow rate are also discussed.

Copies of "Not An Element Of Doubt" are available in English, French, Spanish and Portuguese.

### Snap-On's Tool Buying Guide

Snap-On's new 156-page industrial tool catalog 581 is a hand-tool buying guide for purchasing agents, engineers, production and maintenance officials. As a matter of fact, anyone concerned with the use of hand tools should have one handy.

Users of power-driven nut runners and impact wrenches will find this book a handy order guide for every socket need.

A complete range of automotive tools and shop equipment for car and truck fleets are also included.

### Practical Textbook on Roller Chains and Sprockets

If you are in anyway involved in the selection, applications, installation, lubrication and maintenance of roller chains and sprockets for drives and conveyors, Link-Belt Company's Book 2657 is for you. It's written to serve as a practical textbook on the use of roller chain for both power transmission and conveyor service.

The 154 page book contains typical installation conditions, formulas, charts and diagrams to simplify selection of proper chains for any application. Also described are chain casings, lubrication and maintenance, sprocket engineering, leaf chains and roller chain flexible couplings.

### Onan Electric Plants

A complete line of diesel and gasoline engine-driven generator sets are covered in a series of bulletins released by D. W. Onan & Sons, Inc. Units for every need are listed and described. Included are portable, stationary and emergency standby units, both air and water cooled.

Ratings, weights, dimensions, optional accessories, etc. are given. Photos show the many compact mounting arrangements possible with these units.

### Silicone Fluids For Mechanical Applications

Research engineers and maintenance equipment designers will find a new 8-page engineering guide to silicone fluids for mechanical applications a practical aid and a valuable reference.

Typical applications cited by the Dow Corning Corp. show how silicone fluids are used to advantage in vibration damping, couplings, etc. Tables, graphs, and figures complement detailed data.

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*A.P. 817*

## new literature

### Applications of Stainless Steel Flexible Hose

Advantages of stainless steel flexible hose in handling heat, pressure and corrosive media are highlighted in a new Allflex engineering data and specification folder. Folder (SSDS-562), issued by the Allied Metal Hose Co. explains how hose is used: to absorb vibration, correct for misalignment and offset motion; as chemical loading hose, for weight tank connections, as an expansion compensator, etc.

The folder gives full engineering information and tabular data on pressure capabilities, flexibility, suggested usage, formula for determining best lengths, etc.

### Bendix Filter Catalog

"Bendix Filtration—A Safe Course to Follow" is the title of the 112 page catalog published by the Bendix Filter Div. of Bendix Aviation Corp. Their complete line of air and oil filters are thoroughly described and illustrated.

Dozens of diagrams, tables charts and curves help you to select and understand the filter most suitable for your application. The subject of filtration is covered in detail including a discussion on basic filter media, rating and testing of micronic filters, etc.

### Tools For Repair Shops

Repair shops interested in grinding of diesel engine cylinder blocks, heads, etc. should read Bulletin MO5M-47 put out by Peterson Welding Laboratories.

This bulletin tells how Peterson's universal wet grinders can save time, money and space for you. Described are: easy one-man set-ups; one-pass grinding; no blind grinding; positive control; and compact design of the machine.

Bulletin No. PS018, by Peterson Machine Tool Inc., gives details on their Sonoflux magnetic inspection equipment. Over 18 basic models of wet method magnetic inspection crack detection machines are included in this line. Major features of these units are also covered.

### Brochure on Materials Handling Films

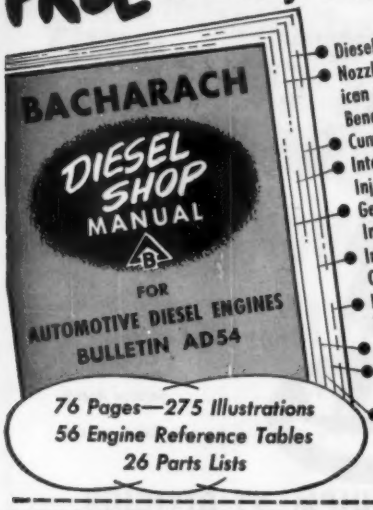
The Industrial Truck Div. of Clark Equipment Co., has published a brochure describing 17 motion picture films available from the company.

Both in color and in black and white, the films depict successful materials handling systems in lumber, railroad, trucking, and other industries. Also available are a film on safety training for fork truck operators and a film on industrial applications of straddle carriers. All films are 16 mm., with running times of eight to 29 minutes.

Clark films are available on a loan basis. There is no charge other than return transportation.

(*Continued on Page* 55)


**FREE to Every Shop Operator**

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- Nozzle Testers for American Bosch, Caterpillar and Bendix Nozzles
- Cummins Injector Tester
- International Harvester Injection Testers
- General Motors Injector Testers
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AD-15

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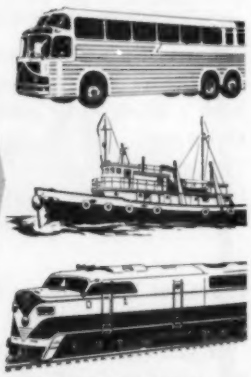
**BETTER SWITCH TO LIX DIESEL CLEANERS!**



You'll like what LIX does for your diesels! Cleaning time shortened to the minimum . . . costs cut 'way down! Lix soaks away all grease, grime and caked carbon from torque converters, transmissions, fuel injector nozzles, and other parts—no brushing or scraping at all.

Lix Diesel Cleaners are **harmless** to all metals including aluminum and brass. **Safer,** too—are of low toxicity, not a fire hazard. And **longer life** without frequent charges.

There's a Lix Cleaner for any diesel cleaning job: **spray** or **soak** tank types, **electric equipment** cleaners . . . **NON-CHLORINATED.**

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ASSOCIATION of DIESEL SPECIALISTS — ACCREDITED DEPENDABLE SERVICE — Member — A·D·S


## new literature

(*Continued from Page* 52)

### Tobin-Arp Equipment

The purpose and major features of Tobin-Arp Mfg. Co. equipment are detailed and shown in a bulletin just released.

Included are: the Air-Draulic 20,000-psi pin press for smooth, safe, easy removal and installation of press-fit pins; the pin-fitting machine for precision boring of the piston pin hole; the Air-Draulic 2000-psi press for press-fit pins; and the Micro-Matic hole gauge, graduated in ten-thousandths of an inch, for checking the piston pin hole size.

### Nordberg Radial Engines

The latest engineering and design features of the 2-cycle, diesel, spark-ignition, gas and Duafuel engines are covered in the Nordberg Mfg. Co. Bulletin No. 200A. These features include supercharging of the spark-ignition radial engines for a rating boost of about 50%.

The 16-page bulletin describes the space saving features of radial engines and their versatility. Drawings show simple foundation and minimum building requirements for installation.

### Guide To Qualified Consulting Engineers

Another edition of "Engineering Consultants", directory of the American Institute of Consulting Engineers, is off the press. It contains a list of qualified engineers and their firms, some biographical data, information concerning the services in the fields in which they work, and a classified index for locating engineers for particular types of problems.

Cost is $2.50 per copy for the cloth-bound edition and $1.50 for the paper-covered one.

### Euclid Brochure On Earthmoving Equipment

For those interested in, or in the market for earthmoving equipment, Euclid Div. of GM Corp. has released a brochure describing its entire line of earthmoving equipment. Twenty-four different models are pictured and described.

Included are condensed specs on nine rear dumps, three bottom pumps, three coal haulers, six scrapers, one crawler tractor and two log haulers. Illustrations and brief descriptions of the more important features of each are given.

### Select The Correct Filter

Hilco full-flow filters have many new features. To determine how these may be applicable for use in your equipment, get the Bulletin just issued by the Hilliard Corp., Purifier Div. The filters are designed for full-flow filtration of diesel, gas engine and turbine lubricating and hydraulic oils, also for industrial oils, fuel oil, solvents, coolants, etc.

A data table makes filter selection convenient. It lists specifications on maximum engine horsepower limit for filter, number of cartridges, etc.

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**SAVE TIME AND MONEY BY EMPLOYING FUEL INJECTION SPECIALISTS**

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FLORIDA DIESEL & ELECTRIC CO.
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## *industry news*

(*Continued from Page* 41)

### Diesel Tractors Replace Gasoline Engine—Type In ETMF Fleet

An expansion program highlighted by the purchase of 175 Cummins-powered White 9000 tractors has been announced by East Texas Motor Freight. The company's decision to turn to diesel power was based on tests showing a marked reduction in operating costs. The new equipment allows for new scheduling and slip-seat operations which increase tractor availability by 69%.

The 175 Cummins NH-180 diesel units are replacing 279 gasoline-powered tractors in the ETMF fleet. Besides this greater availability of units, the company switched to diesel to obtain longer engine life, fewer road failures and uninterrupted scheduling. The new scheduling calls for the tractors to run continuously —stopping only for new drivers, pre-departure equipment checkups, and fueling at company terminals.

### Mobile Gas Turbine Generator Set

A closed-cycle gas turbine test facility to serve as a prototype for a several hundred-kw mobile ground unit is being set up by the U. S. Army Engineers at Fort Belvoir, Va.

One feature of the facility will be a control system to maintain a stable turbine speed in order to hold the generator's output voltage at a constant frequency.

CDC Control Services, Inc. has been awarded a sub-contract for design, installation and startup of the turbine speed-control system.

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let us quote on all your wants for Cummins Engine REPLACEMENT PARTS.
piston rings & sleeves, camshafts, upper rocker parts, cam follow parts, push rods, water pump parts, hose assemblies, fuel lines, injector parts, fuel pump parts, cylinder heads, lube pumps & gaskets.
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P/N 5153334
Lots of 6 Sets - $10.00 per set

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P/N 5159837
Lots of 48 - $1.40 each
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## *industry news*

### Daimler-Benz Exports

Daimler-Benz of North America, Inc. will export 2900 diesel-powered busses this year.

Orders already filled include: 700 to Iran; 150 to Greece; 150 to Ceylon and Pakistan; and about 250 to Sweden, Iraq, Nigeria, Venezuela, Ghana, and Cambodia.

### Nordberg 1250-kw Unit Bought By Municipal Plant

A Nordberg 1250-kw, 4-cycle Dual-fuel engine has been purchased by the City of West Point, Nebraska for municipal power plant improvement. The Supairthermal engine is scheduled for delivery in early 1959.

The 8-cyl, 13½-in. bore, 16½-in. stroke engine will be rated 1765 hp at 450 rpm. With addition of this second Nordberg unit, plant capacity will be increased to 4425 hp.

### Sandblasting Equipment "On The Road"

The Clemco traveling display by Clementina, Ltd., is "on the road". This Show is designed to educate distributor personnel in the new equipment used in sandblasting and to allow consumers to see the complete line operating.

The unit will travel 20,000 miles exhibiting in all major marketing areas. Three factory men will be with the display at all times demonstrating and lecturing on the latest methods of surface preparation.

### Metropolitan Transit Co. Buys 30 Mack Buses

Thirty transit-type buses have been bought by Metropolitan Transit Authority, for use on commuter routes in the greater Boston area. The units are powered by Mack's Thermodyne diesels and are equipped with power steering.

The 43-passenger buses will provide special comfort features including extra wide aisles, high head room, double width doors and air suspension.

**on Your Equipment**

**VIKING PUMPS ADD BUILT-IN QUALITY**

Opposite port pump. Custom built.
Stripped pump, to fit equipment.
A hub-mounted fuel pump.
Integrally-mounted pump, flanged connection.

If you are a manufacturer of machines requiring pumps, it will pay you to learn how a Viking rotary pump could add quality, as an integral part of your equipment. The standardization of Viking Pumps on so many pieces of equipment in the industrial field proves their successful performance.

**so, if you manufacture . . .**

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| Paint application equipment | Asphalt distributors |
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They contain sealed ball bearings, are adjustable while running and are encased in a splash proof housing. These two switch governors are supplied for the standard SAE tachometer drive or distributor take-off and for AND20005 engine pad mounting (GA Series).

Other Synchro-Start governors are available with one and three switches with a variation of mountings.

**SYNCHRO-START PRODUCTS, INC.**

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*Manufacturers of*

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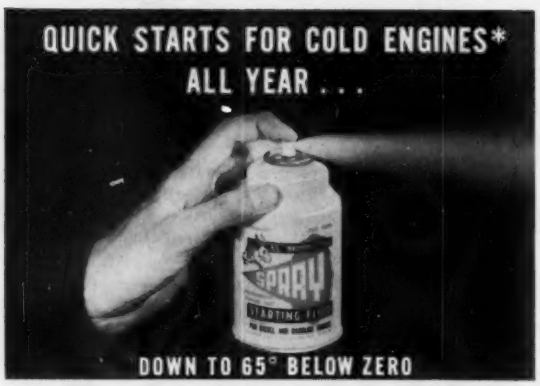


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Garvey's Rig #22, powered by GM "Twin 6-110" Diesel driving Wilson Super Mogul draw works and 7½" x 14" mud pump, drilling near Greensburg, Kansas. Completed 4800-ft. round trip in three hours.

# What made Thief River Falls decide on STANDARD D&G Oil

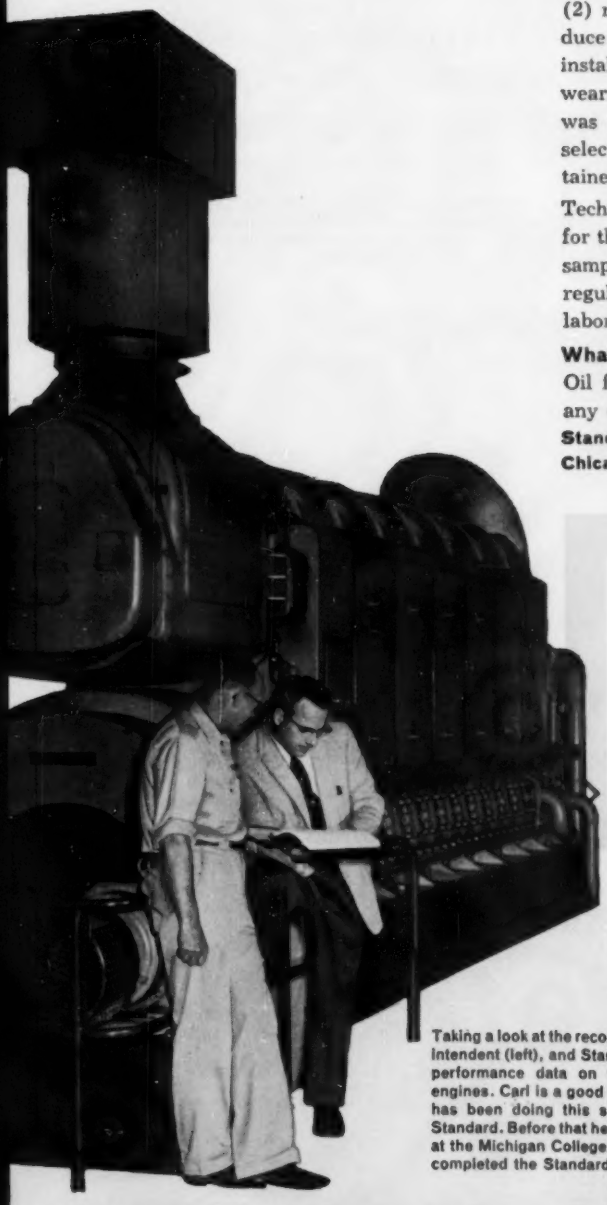
*Two Fairbanks-Morse OP engines turn in top-rated performances with this lubricant.*

**The situation:** In January of 1952 the Thief River Falls, Minnesota, municipal light plant put into service a 10-cylinder, 1,600 hp. Fairbanks-Morse opposed piston engine. In November, 1955, a 1,900 hp. Fairbanks-Morse OP engine was added.

**What was done:** The power plant management discussed lubrication requirements with Standard Oil lubrication specialists. Because of the evidence that STANDARD D&G Oil, with its higher additive level, could (1) reduce ring and wall wear, (2) reduce ring sticking, (3) increase bearing life and (4) reduce engine deposits, this oil was selected for the first engine installed. After 22,000 hours, inspection showed little or no wear. Small wonder then that when the second OP engine was put into service in 1955, STANDARD D&G Oil was again selected. After 7,500 hours, similar performance is being obtained on the newer engine.

Technical service performed by Standard Oil men pays off for the power plant management. Standard men take frequent samples for field inspection of oil condition. Other samples are regularly taken for transmittal to Standard's Whiting, Indiana, laboratory for complete analysis.

**What you can do:** Get more facts about STANDARD D&G Oil from the Standard Oil lubrication specialist near you in any of the 15 Midwest and Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**



Taking a look at the record. Morris L. Owen, plant superintendent (left), and Standard Oil's Carl Klenner look at performance data on the two Fairbanks-Morse OP engines. Carl is a good one to talk things over with. He has been doing this sort of work for 10 years with Standard. Before that he received an engineering degree at the Michigan College of Mining and Technology and completed the Standard Oil Sales Engineering School.

### *Quick facts about* STANDARD D&G Oil

- Made from highest-quality solvent-refined stock.
- Contains additives which impart superior detergent-dispersant and anticorrosion properties.
- Antifoaming.
- Oxidation-resistant.
- Recommended for use (1) with economy fuels (2) in extreme-load and/or low-temperature service.

*You expect more from* STANDARD *and get it!*